ENGINEERING NEWS

A JOURNAL OF CIVIL, MECHANICAL, MINING AND ELECTRICAL ENGINEERING

Vol. 60. No. 14. 220 Broadway, New York, October 1, 1908.

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TRACK DEPRESSION OF THE SEABOARD AIR LINE RAILWAY AT BIRMINGHAM, ALA.

By PHILIP AYLETT,* Assoc. M. Am. Soc. C. E.

The Birmingham extension of the Seaboard Air Line Ry. from Atlanta, Ga., to Birmingham, Ala., known during construction as the Atlanta and Birmingham Air-Line Ry., was completed late in 1904, after several years of expensive construction work. Along its 170 miles between Atlanta and Birmingham there are three tunnels and numerous viaducts, bridges and culverts. At Howells, Ga., a suburb of Atlanta (and the junction of the Birmingham extension), are located the eastern or Atlanta terminals, consisting of extensive yards, shops, etc. At Birmingham, the western end, there are also extensive terminals.

One of the special features of this line is a track-depression in Birmingham for a length of about 1,800 ft., along Avenue A, between 20th and 24th Sts., by means of which a double-track entrance was effected to the freight station located at the northwest corner of Avenue A and 20th St., in the heart of the business district of the city. The passenger trains of the Seaboard enter the Louisville & Nashville Union Station over a connecting track leaving the main line at 32d St. Therefore the Avenue A line, between 32d and 14th Sts. is for the present used exclusively for freight traffic. In the event of further extensions west, however, it would form the most direct main line possible through the city.

COMPLETED TRACK DEPRESSION, LOOKING WEST FROM EAST END AT 24TH ST.

In the construction of the Avenue A tracks between 32d St. and the freight station for the most part the tracks were laid on the street surface, involving no difficult or expensive work. It was necessary, however, to depress the four blocks between the grade crossings of 24th and 20th Sts., on account of topographical conditions, as shown by the profile in Fig. 1. This part of the work involved many difficulties in drainage, in securing the requisite overhead clearances, and in maintaining street traffic during construction.

With the possession of complete data, obtained by the writer's surveys of this entire locality, it was found that there were at least two other routes by which a connection to the freight station could have been made. One of these appears to possess many advantages, and would probably have received favorable consideration and final adoption had it been presented to the attention of the management in proper form at an earlier stage. At the time of the writer's connection with this work, however, the large expenditures already incurred in the way of property damages, litigation and other preliminaries, precluded serious consideration of any other route than that built and described.

On 22d and 21st Sts., city viaducts extended over the terminal tracks of the several other railways lying between Avenue A and First Ave. The 22d St. viaduct, carrying a double-track electric railway line, terminated on the north building line of Avenue A. The viaduct on 21st St. extended to the center line of the street, spanning the depressed north half of the roadway. The two halves of Avenue A have different elevation for nearly the entire length of the two blocks between 20th and 22d Sts., the elevated south half forming approach inclines to the 21st St. viaduct, while the low north half gave access to the abutting property, passing under the viaduct at approximately the elevation of the adjacent railway yards. The south half (high level) was retained for 357 ft. by a masonry retaining-wall, which where passing under the viaduct served as its abutment. This wall had to be removed for its whole length, the viaduct span lengthened and a new abutment provided over the concrete retaining-wall to be built along the track depression.

City requirements as to elevations at the ends of the depressed portions and underclearances at 21st and 22d Sts. (18 ft. in both cases), and the necessity of drainage, had the result that the elevation of track was fixed at every street-crossing from 20th to 24th Sts., inclusive. The resulting profile is fully shown by Fig. 1.

GENERAL FEATURES.—The general scheme as proposed and executed, contemplated the construction of two concrete retaining-walls (Fig. 2), each 13 ft. 6 ins. from the center line of Avenue A (27 ft. apart in the clear). The foundations of these walls are parallel approximately to the depressed tracks, while their tops are parallel to the street surfaces above which they project to form a substantial railing between the roadway and the depressed tracks.

In order to maintain street traffic, one wall was constructed at a time and, after backfilling the first for street traffic, the excavation and concreting of the second wall was undertaken. The core of material between the completed walls was then excavated by steam shovel and used in backfilling as the work advanced.

Each retaining wall is 1,830 ft. long and terminates 10 ft. east and west of the building lines of 20th and 24th Sts., respectively. The general design is simple, as the sections in Fig. 2 exhibit, comprising a massive concrete retaining wall with vertical face and inclined back, rising to a height of 8 ins. above the pavement. Above this, and offset 4½ ins. inward from the back of wall, is a top section which forms a parapet wall projecting 3 ft. 5 ins. above the street surface. The back or street face of this parapet has a batter of 3 ins. per foot. Thus the street is provided with a battered curb 8 ins. high, which has proven very effective as a protection, surmounted by a battered parapet of concrete.

The coping or top rail of the parapet overhangs 3 ins. on front and back, and its upper surface is formed by two inclined faces which intersect in the vertical plane of the track face of the retaining-wall. This sheds toward the street most of the water falling on the coping, and not only presents a very uninviting seat to loafers, but also is "boy-proof," affording no temptation as a walkway. The railing has an excellent appearance and is a thorough safeguard.

The walls and railing were built in one monolithic mass to bottom of coping, the latter being subsequently cast in place.

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DRAINAGE.—In the surveys and designs the questions of drainage and underclearance were of prime importance, especially the former on account of the large volume of water to be disposed of during heavy rainfall. The descending grades of the yards and main line from 32d St. westward to 21st and from 20th St. eastward, together with other topographical conditions and the fact that the depressed area within the retaining-walls is lower than any other within the drainage area, made it evident that the entire rainfall upon the surrounding territory must naturally pass within this depression. Therefore a very effective and unfailing system of drainage was necessary to successful operation and maintenance of the entire project.

The system of drainage constructed has proven entirely satisfactory. A concrete box drain with inside clear dimensions of 24 × 12 ins. is constructed on the center line between tracks, from the west building line of 24th St. to a catchbasin under the 21st St. viaduct, the lowest point of the depression. Between the catchbasin and 20th St. no box drain is provided, as the volume of water entering the depressed area from the west is comparatively small and the grade of the roadbed is sufficient to afford effective drainage to the catchbasin along the sub-grade. The bottom of the drain is 2 ft. 5 ins. below and parallel to the base of rail, except that where the tracks are level it has a fall towards the catchbasin of 0.20%. The top of the drain, however, has the same relative position to the track everywhere, namely 1 ft. 2 ins. below and parallel to base of rail. Two types of cross-sections of the box drain were designed. That shown by Fig. 3 is for rock foundation; the earth section is the same except that the thickness of base is increased to 4 ins. on hard earth and more on soft bottom.

The roadbed subgrade is sloped transversely about 1⅜ ins. per ft., draining from each retaining wall towards the box drain in the middle. The side walls of the box drain are provided with 6 × 3-in. inlet holes, spaced 5 ft. c. to c. for its entire length, the inlets being staggered in the opposite walls. The base of the box is extended 12 ins. beyond its walls on either side and the surfaces of these extensions have slopes continuous with those of the subgrade. The projections thus form side gutters for the passage of water to the inlets. Obstruction of gutters and inlets by ballast is avoided by the use of large lumps of clean slag deposited on the base-projections adjacent to the side walls of the box drain from end to end.

The forms for the inlet holes consisted simply of two wedges. The cover slabs of the drain, 3 ins. thick, were cast in 2-ft. to 4-ft. lengths and were laid loosely in place, spaced about ½-in. apart for top drainage. The slabs were cast under cover and were well seasoned before placing.

The catchbasin, 2 ft. × 3 ft. in cross-section by 27 ins. deep, has a flat concrete cover like that of the drain, but 4 ins. thick (Fig. 3). It is reinforced with round bars which extend out at the ends to form handles. The drain enters the catchbasin at the top. Although there is no drain on the 20th St. side, the catchbasin was provided with an inlet and a 12-in. length of drain on this side so that the drain can be extended westward if this is found desirable at any future time. The catchbasin is drained by a 15-in. terra-cotta pipe 974 ft. long, laid on a grade of 0.205%, to a 30-in. brick sewer on 19th St. Tunneling was necessary to carry this pipe under 20th St., with its electric railway tracks, sewer, etc.

OVERHEAD STRUCTURES.—The required underclearance at street crossings and the existing street grades limited the construction depth at 21st and 22d Sts. to 30 ins. and 26½ ins., respectively. This made special design necessary for the crossing structures. The clear span of 27 ft. between retaining-walls and the loading specified by the city called for 15-in. 80-lb. I-beams spaced 2 ft. c. to c. It was no easy matter to accommodate the 15-in. beams, 9-in. track rails, paving and sand cushion within the depth limits.

The double-track electric railway on 22d St. crosses Ave. A on a 2% grade descending south, which grade had to be provided for in the beam-and-concrete structure. This condition was met without either exceeding the depth limit or encroaching on the rectangular clearance profile, by setting the rails, stringers and pavement to the street gradient, but keeping the main 15-in. I-beams level. Between the two I-beams either side of each rail were riveted 8 transverse 9-in. 21-lb. I-beams (Fig. 8), set at varying elevations to conform to the 2% grade. These 9-in. beams were set with webs vertical, and with plane of top flange 12 ins. below top of pavement. On the 9-in. beams were bolted 5 × 12-in. oak timbers to carry the street-railway rails, the latter being spiked to the timbers. This brought the top of rail flush with finished surface of pavement and provided cushion and insulation for the rail. The transverse grade of the structure (and therefore of the beam seats) was made the same as the grade of the depressed tracks, i. e., 0.835% descending west.

The roadway floor is formed by concrete filling between the beams, which latter are spaced ordinarily 2 ft. on centers. The filling extends 1 in. above the top flange and 1½ ins. below the bottom flange of the beams, so as to encase them entirely. At the junction of the bottom face of the structure with the vertical face of the retaining walls the concrete was curved downward in the form of a fillet or cove, which not only adds to the appearance, but also strengthens the structure by producing partial fixity of the ends.

On account of the abandonment of a crossing over the depressed tracks at 23d St., the city required that the 22d St. crossing be extended as far west as the 18-ft. underclearance would permit. This gave a total length of crossing of 140 ft., of which 50 ft. is east and 90 ft. west of the center line of 22d St. The ends of the crossing were flared out by special beam and railing construction to form an easier approach from the narrow strip of Avenue A on either side.

Fig. 4 shows this crossing after completion, while Fig. 6, a view looking east from the site of the crossing before its erection, shows the recesses in the walls for the seat of the easterly approach end on the southerly side of Avenue A.

At the 21st St. crossing, where there is no street-car track, the flooring consists merely of 15-in. beams with concrete filling. The concrete between the beams was reduced in amount by barrel-vault hollows produced by special forms as shown in Fig. 7.

This crossing is a new structure over the railway depression; the viaduct portion to the north was affected by the necessity for removing the columns from the north roadway of Avenue A, which required replacing of three old spans and strengthening the bent at their north end. The span over the track depression is trapezoidal in plan, being considerably wider at the south wall than at the north wall, thus giving easier approach from the southerly (high-level) roadway of the avenue. The 15-in. I-beam floor stringers run parallel to the center line of the structure, and where they do not have the full span they frame into plate-girders extending along the edges of the roadway. At the sidewalk edge is a pony lattice-truss, parallel to the plate-girder, which carries the outer end of the sidewalk floor-beams. This lattice-truss serves at the same time as a very substantial railing. At its northerly end it connects directly with the old railing, which was replaced on the adjacent viaduct after the erection of the new girder span over the low north roadway.

The details of the steelwork and the connections between the old and new portions worked out so nicely that but for new painting and differences in weights and sizes of new members the blending of the old with a new structure is hardly noticeable.

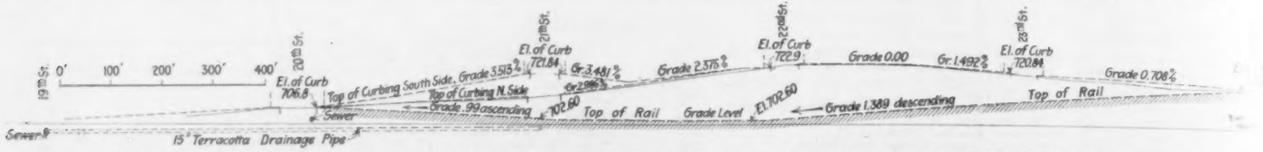


FIG. 1. PROFILE OF TRACK DEPRESSION ALONG AVENUE A, BIRMINGHAM, ALA.; BIRMINGHAM EXTENSION OF SEABOARD AIR LINE RY.

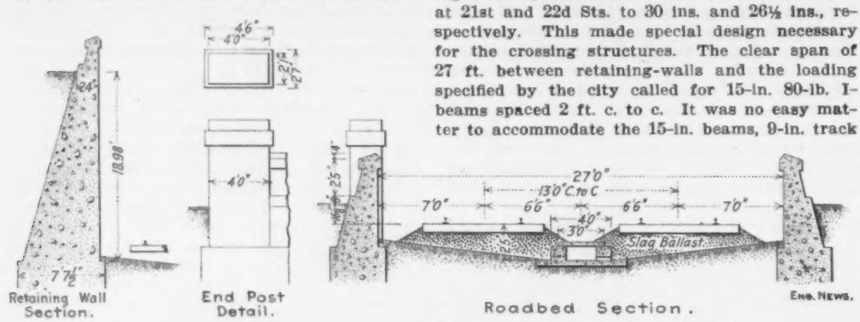


FIG. 2. SECTIONS OF DEPRESSED ROADBED AND RETAINING WALL.

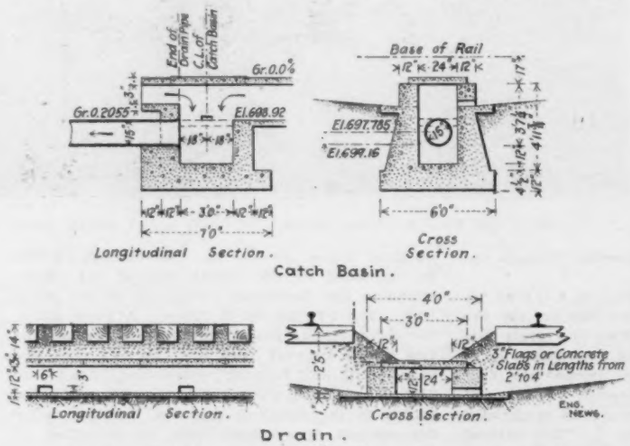


FIG. 3. DETAILS OF DRAIN CULVERT AND CATCHBASIN.

CONSTRUCTION.—As already mentioned, the two retaining-walls were built one at a time, in a trench excavated only wide enough for the wall and its forms.

Solid rock was encountered at 2 to 5 ft. above sub-grade, with clay and loam overlying. The foundation level of the wall, following the track grade, was not horizontal longitudinally, and to obtain level footings the rock was cut in 12-in. steps 72 to 100 ft. long.

The wall was built in corresponding sections, excavation and wall-construction being completed for one section at a time. The excavated material was used for backfilling behind the sections already built. Double track was laid in the center of the street, and from a switch at 24th St. a temporary track was laid behind the wall, from which the cars dumped the backfill.

Heavy sheeting was necessary to protect the excavations and the street. A number of springs were encountered bubbling through crevices in the rock, which caused much trouble, and in every section pumping was necessary.

The foundation concrete was placed on the cleaned surface of the rock, after all deep pockets had been filled with slag to save cost and to prevent the contact of concrete with clay where this could not be thoroughly removed from a pocket. Forms were built after concrete had been carried up to the neat line elevation, 19 ins. below base of rail, the foundation having a 6-in. offset both front and rear beyond the neat-line dimensions.

The forms for the front or track face of the wall were made of 2 × 9-in. plank dressed on one side, and 2 × 4-in. studs spaced 3 ft. The forms for the rear face were of 1 × 12-in. boards, left rough except those for work above the street surface, which were planed on one side.

The retaining-walls have expansion joints every 35 ft. for their entire length. This spacing has proven sufficient to meet all requirements of temperature change for this locality. The joints pass up through the full height of the wall, including railing and coping. They were formed by inserting wood partitions in the wall forms, covering the entire face of the partition with several thicknesses of roofing felt and then nailing triangular strips of wood in the corners and in the center. After completing a section of wall and removing the partition, the felt remained in contact with the concrete and the adjacent section was molded against it.

Weep holes were cored in the walls at frequent intervals, at the level of the foundation offset.

Concrete columns were constructed at the ends of the retaining-walls, which, besides adding much to the appearance of the work, serve as fenders for the street traffic. For the latter purpose, 6-ft. lengths of 60-lb. rail are buried 3 ft. in the ground, sloping toward the columns. Such columns were also constructed at the entrances of the 21st and 22d St. crossings. Their transverse dimensions are 25 × 48 ins. in the shaft.

The strength of the retaining-walls, both as to design and execution, was proved by a construction accident which formed a very severe test of the wall. This accident occurred at the highest point of the wall shortly after this section had been completed and backfilled. Several gondola cars heavily loaded with steel, etc., were stationed on the temporary track laid on the backfill behind the wall at this point. A heavy rainfall caused the backfill under the cars to settle nearly three feet, and this broke a 10-in. water main. The flow from the main flooded and undermined the entire backfilled prism, causing the adjacent soil to cave against this comparatively green wall, already burdened with the load of saturated earth and loaded cars. No injury was apparent after this accident, and no change in the alinement of the wall resulted.

22ND ST. CROSSING.—Placing the floor and protection concrete of the overhead structures involved some interesting work. At the 22nd St. crossing the concrete between the beams, which also extends 1½ ins. under the bottom flanges so as to encase the beams completely, is curved downward at the abutment, making a large fillet between wall and horizontal work. The bottom forms for the concrete were suspended from the 15-in. I-beams by ¾-in. bolts encased in tar-paper tubes to facilitate the removal of the bolts after the setting of the concrete. Then the curved forms for the fillets were placed, being supported by the 4-in. coping of the abutments and also by 6 × 6-in. posts extending to the foundation offsets of the walls. No concrete was deposited until both suspended and side curve forms were in position for one half the entire crossing. This enabled the concrete between the beams and that forming the side curves to be placed simultaneously from spring to spring of side arches, the entire monolithic beam-covering thus being anchored to the wall-abutments by means of anchor bolts in the bridge-seats. In this way cracks and joints, through which injurious locomotive gases invariably penetrate, were eliminated and the beams given perfect protection.

A clearance of 1½ ins. was provided between the top surface of suspended form and the lower beam flanges. Within this space a ¾-in. layer of 1:2 mortar was placed on the horizontal form. Sheets of No. 10 expanded metal 18 ins. in width were then placed upon the mortar and worked well into it until the meshes were filled. A second layer of cement mortar was then packed over the expanded metal up to and enveloping the lower flanges of the beams. The expanded metal prior to placing was bent in the form of a channel of width slightly greater than the beam flange, all points being kept at least one inch from the nearest point of the beam. The concrete was finished off 1 in. above the top flanges of the I-beams, flush with the parapet walls.

To secure perfect contact between steel and concrete, the beams, rods, etc., were not oiled or painted. It has been the writer's practice to allow all metal which is to be embedded in concrete to be exposed to the weather long enough to become slightly rusted—without scaling.

In order to avoid formation of expansion cracks between the railing of the crossing and the parapet on the retaining walls, frequent expansion joints (Fig. 7) were provided near the corners. These joints were particularly important here on account of the corners, and changes in direction of the railing, a condition which always forms a prolific source for expansion cracks in any concrete structure.

FIG. 4. VIEW OF 22D ST. BRIDGE, LOOKING EAST.

FIG. 5. VIEW OF 21ST STREET VIADUCT CROSSING, LOOKING EAST.

FIG. 6. LOOKING EAST FROM 22D ST. AFTER CORE EXCAVATION, SHOWING WORK OF DRESSING ROADBED.

21ST ST. CROSSING.—The old retaining wall at the center of Avenue A, which carried the end of the vidauct on 21st St., was left in place until the new walls were built. The supporting bent just north was removed, however, and the deck carried by temporary wooden supports during this construction. Then the old deck was shortened, reinforced to span from the north retaining wall to the second bent, and this bent replaced at the same time by a stronger one. The span between retaining walls was all new work. The forms for concreting the floor in this span were similar to those used at the 22d St. crossing.

In both crossings the form work was designed so that trains could pass under it during the course of the concrete work.

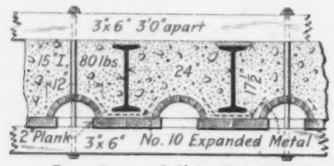
"HOT-POT" SLAG CONCRETE.—A noteworthy feature of the concrete work is the use of "hot-pot" slag as aggregate throughout. This slag is available in large quantities at the blast furnaces in Birmingham and vicinity, and the only cost of obtaining it was the handling and transportation cost. As no concrete work of any magnitude was known in which this slag had been used as the aggregate, unusual care was taken in mixing, etc. Experience soon showed that an essential requirement with this material is to mix it thoroughly with the sand and cement when dry; in fact, the slag may not even be previously wetted, as is often done with crushed stone. This precaution was necessary in both hand and machine mixing, to avoid trouble from lumpy concrete, from clogging of the mixer, or from small fragments of slag sticking to shovels and wheelbarrows.

The concrete produced has proven to be of excellent quality. Tensile and compressive tests of specimens several years old, as well as examination of the concrete in the structures with chisel and drill, show the strength and durability to be entirely satisfactory, as is also the appearance of the concrete surfaces. As a result of the experience with this material in the Birmingham work, it was adopted also for the abutments and piers of an important railway bridge over the Coosa River; these piers are 55 ft. in height, and stand in a swift current, in water 15 to 20 ft. deep.

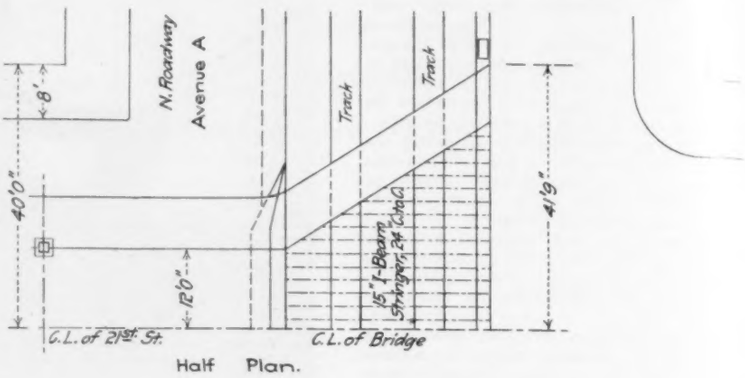
By far the largest part of the concrete in the retaining walls was mixed by machine. A No. 2 Smith mixer driven by steam-engine was used. The slag for foundations and for the body of the walls was broken to a size passing a 2-in. ring; for copings, bridges, railings and columns ¾-in. slag was used. It was required to be free from dirt or cinders and to have a clean, vitrified appearance.

There is a total of 11,000 cu. yds. of concrete in this entire work.

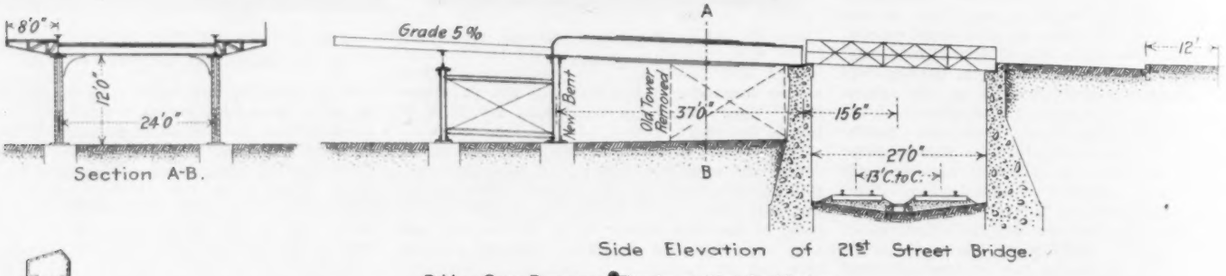
Much credit is due the concrete contractors, Vaughn & Son, of Roanoke, Va., and the steel contractors, the American Bridge Co., and their foremen, for their painstaking and successful handling of this work, and the faithful manner in which the specifications were followed. The writer also wishes to acknowledge his thanks and indebtedness to Mr. Julian Kendrick, City Engineer of Birmingham, for his valuable aid, suggestions and many acts of kindness, and to Mr. W. C. Watson, Assistant Bridge Engineer S. A. L. Ry., Mr. James Bruin, Chief Inspector, and Mr. Thos B. Cox, Inspector of Erection. During the construction of this work Mr. W. W. Gwathmey was Chief Engineer of the Seaboard Air Line Ry., to whom the writer reported and from whom he received instructions.



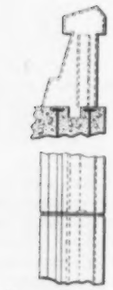
Floor Forms, 21st St. Bridge.

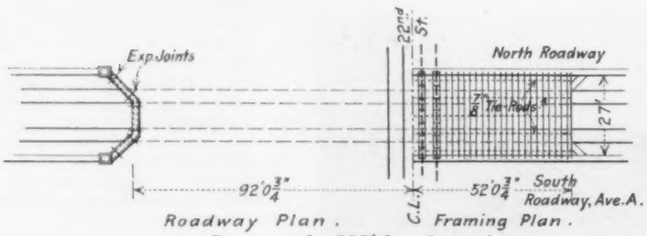


Half Plan.

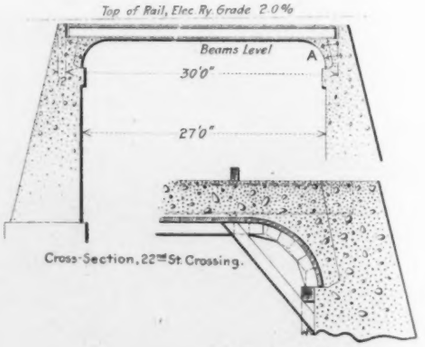


Bridge Over Depressed Tracks at 21st St. Viaduct.

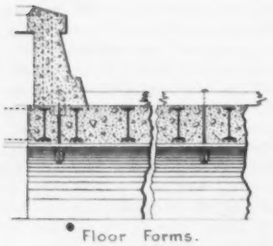

Expansion Joints in Railing.

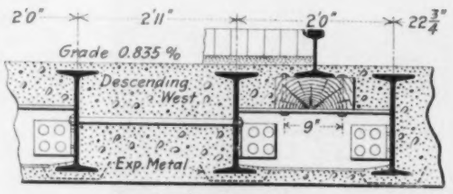


Plan of 22nd St. Crossing.



Cross-Section, 22nd St. Crossing.


Floor Forms.



Rail Support.

Form for Fillet "A".

Bridge Over Depressed Tracks at 22d St.

FIG. 7. DETAILS OF OVERHEAD BRIDGES AT 21ST AND 22D STS.

IRON ORE PRODUCED IN RUSSIA was greater in 1907 than hitherto, and amounted to 4,227,419 tons, which is said to be exclusive of the manganese ore exported from Poti. The quantity exported was 881,222 tons, as compared with 464,016 tons in the previous year. The South Russian metallurgical works were supplied with 83,870 tons more iron ore during the year under review than in the preceding year, while the quantity remaining in stock at the close of the year was 500,000 tons, as compared with 161,290 tons in 1906. The above figures were reported in the London "Engineer."

THE MINERAL ANALYSIS OF WATER FOR INDUSTRIAL PURPOSES AND ITS INTERPRETATION BY THE ENGINEER.

By HERMAN STABLER.*

Recent practice among water analysts tends towards the statement of analyses in ionic form, in parts per million, and the abolition of the statement in grains per gallon of mineral salts supposed to be present. The interpretation of the analysis can be made from either form of statement without great difficulty. The newer form, although admittedly better in many respects than the old, is, nevertheless, comparatively unfamiliar to many and its interpretation in consequence somewhat obscure. Herewith are presented a few simple calculations and formulas which will assist in clearing up this obscurity and enable one not well grounded in chemical nomenclature to interpret and compare analyses expressed in ionic form, in parts per million, and to classify waters for industrial purposes. The calculations presented include only soap consumption, water softening, and interpretation for boiler use, but may be readily enlarged in scope to include all industrial water problems.

THE ANALYSIS.—A mineral analysis of such waters as are ordinarily used for industrial purposes includes four classes of water impurities: suspended matter, colloidal matter, dissolved solids, and dissolved gases.

Suspended matter includes all organic or inorganic matter that can be removed by filtering. It is of a complex nature and consists of many chemical compounds which are not usually determined in detail. Suspended matter will be herein designated SM.

Colloidal matter includes for the most part silica (SiO_2), alumina (Al_2O_3), and iron oxide (Fe_2O_3), though in polluted waters a considerable amount of organic matter may be present in the colloidal state. This material is present in a state intermediate between suspension and true solution. In the mineral analysis it is not distinguished as such, but the three mineral components above mentioned are determined separately, as though present in solution. There is always some doubt as to whether the silicon, aluminum, and iron are actually present as the oxides in the colloidal state or as ions in true solution. In this article the iron and aluminum are included both in the dissolved and colloidal matter in order that both possible cases may be covered, but the silicon, because of its very rare occurrence in appreciable quantity in any other form, is included only under the head of colloidal matter. As stated later, the individual analysis may indicate definitely the state of these substances, but if not it is a safe rule to consider them as being present in the colloidal state. The term colloidal matter, as here used, means the oxides of silicon, iron, and aluminum and will be designated CM.

Dissolved gases are not often determined. Those of most importance industrially are carbon dioxide (CO_2) and hydrogen sulphide or sulphuretted hydrogen (H_2S). Because of its rare occurrence in sufficient quantity to affect them materially, hydrogen sulphide is omitted from the calculations and formulas here presented. The carbon dioxide will be included and expressed in parts per million.

Dissolved solids, as here used, refers to the mineral solids actually dissolved in the water. The usual determinations included under this term are iron (Fe), aluminum (Al), calcium (Ca), magnesium (Mg), sodium (Na) potassium (K), acidity (H), carbonate radicle (CO_3), bicarbonate radicle (HCO_3), sulphate radicle (SO_4), chlorine (Cl), and nitrate radicle (NO_3). Acidity is variously reported as hydrochloric acid (HCl), sulphuric acid (H_2SO_4), calcium carbonate ($CaCO_3$) and hydrogen (H). It is here expressed as hydrogen and may be converted to this form from the others by the following factors:

$$H = .0276HCl = .0206H_2SO_4 = .0202CaCO_3.$$

The following will represent the form of analysis statement upon which the calculations are based:

Constituent.	Symbol.
1. Suspended matter	SM
2. Colloidal matter	CM
(a) Silica	SiO_2
(b) Iron oxide	Fe_2O_3
(c) Alumina	Al_2O_3
3. Dissolved gases	DG
Carbon dioxide	CO_2
4. Dissolved solids	DS
(a) Iron	Fe
(b) Aluminum	Al
(c) Calcium	Ca
(d) Magnesium	Mg
(e) Sodium	Na
(f) Potassium	K
(g) Hydrogen	H
(h) Carbonate radicle	CO_3
(i) Bicarbonate radicle	HCO_3
(j) Sulphate radicle	SO_4
(k) Chlorine	Cl
(l) Nitrate radicle	NO_3

ACCURACY OF ANALYSIS.—The constituents included under dissolved solids constitute a chemical system of positive and negative ions (which may or may not be in actual combination), each of which has the power to react with or hold in the system a definite weight of ions of the opposite sign. This power will be here designated as the "reacting weight" of the ion. The division into positive and negative ions and the reacting weights of the ions are as follows:

Positive Ions.	Reacting weights.	Negative Ions.	Reacting Weights.
Iron (Fe)	.0358	Carbonate radicle (CO_3)	.0333
Aluminum (Al)	.1107	Bicarbonate radicle (HCO_3)	.0164
Calcium (Ca)	.0499		
Magnesium (Mg)	.0821	Sulphate radicle (SO_4)	.0208
Sodium (Na)	.0434	Chlorine (Cl)	.0282
Potassium (K)	.0255	Nitrate radicle (NO_3)	.0161
Hydrogen (H)	.992		

If the number of parts per million of each constituent ion found by analysis be multiplied by its reacting weight, a number will be obtained which may be called the "reacting value" of the ion for that analysis. This will be designated by the letter R prefixed to the symbol of the ion. Thus, RCa will represent the reacting value of the calcium in any analysis.

The accuracy of the analysis may readily be estimated from the reacting values of the constituent ions, for in the chemical system which they form the sum of the reacting values of positive ions must be equal to the sum of the reacting values of the negative ions. The percentage error due to inaccurate analysis, undetermined ions, etc., may be found from the formula:

$$(1)\quad E = 100\,\frac{RP - RN}{RP + RN}$$

in which E = percentage error, RP = sum of reacting values of positive ions, and RN = sum of reacting values of negative ions. In this calculation the iron and aluminum ions should be omitted, the assumption being that these substances are present as colloidal oxides. Usually, with fairly careful work, E will not exceed 5 in numerical value and may generally be expected to be 2 or less. A value of E in excess of 5 will indicate: (1) a blunder in analysis or calculation of same; (2) if negative, the presence of iron, aluminum, or some undetermined positive ion; or (3) if positive, the presence of the silicate or some undetermined negative ion. Individual judgment must decide which of these causes of error is the most probable and reject the analysis or correct the form of statement of the same in accordance with the magnitude and character of the error and the relative abundance of the ions most likely to be involved. The correction of an analysis in this manner is generally an unreliable makeshift, but can occasionally be made with a high degree of probability.

SOAP CONSUMING POWER.

Whipple* has deduced from a series of experiments the cost of consumption of the common household soaps by waters of various degrees of hardness. Iron, aluminum, calcium, magnesium, and hydrogen ions in the dissolved solids are the soap consuming constituents of water. Therefore, accepting Whipple's values, the cost per 1,000 gals. for soap necessary to produce a lather in water is as follows:

(2) Soap cost

$$= 9 + 50.05\,(RFe + RAl + RCa + RMg + RH)$$
$$= 9 + 1.79\,Fe + 5.54\,Al + 2.5\,Ca + 4.11\,Mg + 49.6\,H$$

WATER SOFTENING.

Hard water has such a deleterious effect in most industries that the practice of "softening" the water before use has become prevalent in regions where soft waters are not obtainable. The principal so-called hardening constituents are calcium and magnesium, and by reason of their cheapness lime and soda ash are the chemicals customarily used in the softening process. The lime is introduced as the hydroxide, $Ca(OH)_2$, and the soda ash as Na_2CO_3. By the soda-lime method of softening, the hydrogen ion is changed to water; calcium, magnesium, iron and aluminum ions are removed as precipitates; the bicarbonate ion and carbon dioxide are changed to carbonate ion and water, and part or all of the carbonate ion removed as a precipitate. The calcium added as $Ca(OH)_2$, as well as that already in the water, is precipitated as calcium carbonate ($CaCO_3$). The sodium added as Na_2CO_3 remains in solution, taking the place of bases precipitated or otherwise removed from the chemical system. The reactions that apparently take place are:

$Fe + 2OH = Fe(OH)_2$, which falls as a precipitate
$Al + 3OH = Al(OH)_3$, which falls as a precipitate
$Mg + 2OH = Mg(OH)_2$, which falls as a precipitate
$Ca + CO_3 = CaCO_3$, which falls as a precipitate
$H + OH = H_2O$
$HCO_3 + OH = CO_3 + H_2O$
$CO_2 + 2OH = CO_3 + H_2O$

From the foregoing reactions, it appears that lime must be added in quantity sufficient to provide hydroxyl (OH) to combine with the iron, aluminum, magnesium, bicarbonate and hydrogen ions, and with carbon dioxide. In addition, if the carbonate ion in the water plus that formed by change of the bicarbonate ion and carbon dioxide is not sufficient to precipitate the calcium present in the water, and added as lime, an additional quantity must be provided by the addition of soda ash in order that all the calcium may be precipitated. This latter consideration determines the amount of soda ash to be added.

In terms of pounds of 90% lime (CaO) and 95% soda ash (Na_2CO_3) per 1,000 gals. of water, these statements may be expressed in the following formulas:

(3) Lime required:

$$= 0.26\,(RFe + RAl + RMg + RH + RHCO_3 + .0454CO_2)$$
$$= .00931Fe + .0288Al + .0213Mg + .258\,H + .00426\,HCO_3 + .0118CO_2$$

(4) Soda ash required:

$$= 0.465\,(RFe + RAl + RCa + RMg + RH - RCO_3 - RHCO_3)$$
$$= .0167Fe + .0515Al + .0232Ca + .0382Mg + .462H - .0155CO_2 - .00763HCO_3$$

Assuming the average cost of lime to be 0.3 cts. and of soda ash to be 1.2 cts. per lb., the cost in cents per 1,000 gals. of chemicals for softening a water can readily be determined from formulas (3) and (4), as follows:

(5) Cost of chemicals for softening:

$$= .636\,(RFe + RAl + RMg + RH) + .558\,(RCa - RCO_3) + .00354CO_2 - .48RHCO_3$$
$$= .0228Fe + .0704Al + .0522Mg + .631H + .0279Ca + .00354CO_2 - .0186CO_2 - .00787HCO_3.$$

A negative value for formula (4) shows that no soda ash is required. In such case, instead of using formula (5), take .3 the value of formula (3) for cost of chemicals. Formulas (2), (3), (4), and (5) may usually be simplified for practical use by the omission of iron, aluminum, and hydrogen, for they are not often present in sufficient quantity to affect the results.

Similar formulas can readily be deduced for use in connection with water softening by other chemicals, but their practical application would be small. In connection with the water-softening problems, it should be remembered that the reactions quoted above and the resulting precipitation will vary in completeness with conditions of temperature, mixing, sedimentation, etc. Furthermore, the precipitates formed are not wholly

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*The Value of Pure Water, by Geo. C. Whipple. John Wiley & Sons, New York, 1907; pp. 24-28.

insoluble. In a water softened under ideal conditions there may remain in solution 5.2 parts per million of calcium and 3.4 parts per million of magnesium, together with equivalent amounts of negative ions. These figures may be increased by the presence of other substances. On the other hand, a very large percentage of colloidal and suspended matter will be carried down with the precipitates, thus increasing the value of the softening process.

BOILER WATERS.

The chief industrial use of water is steam making. The cost of softening water is a fairly reliable index to its value for this and other industrial purposes. The cost for softening is the sum of two figures, cost for lime and cost for soda ash, the former being about one-fourth the latter. In a general way, the amount of lime required varies with the amount of least objectionable impurities, while the amount of soda ash required varies with the quantity of impurities most deleterious in character. If, therefore, the ill effects of the latter class may be assumed as four times those of the former, the relative cost of chemicals for softening waters will represent their relative objectionableness with a fair degree of accuracy.

The customary method of interpreting the value of a water for boiler use is based upon its tendency to cause foaming, corrosion, and incrustation. Such interpretation is usually made from the hypothetical combination of the ions into salts, judgment of the tendencies of these salts being made in accordance with our knowledge or theories of boiler physics. Unfortunately, our knowledge is rather restricted, though our theories are numerous. It follows that the interpretation cannot always be expressed in very definite terms and if so expressed is liable to error.

FOAMING AND PRIMING.—Foaming and priming are probably the least understood of boiler phenomena. Priming may be defined as an ebullition so violent that water in the form of spray is carried from the boiler before its separation from the steam can take place. It is controlled by the relations of heating surface, evaporation surface, circulation, and working load, all of which are factors of the violence and rapidity of ebullition; and by such features as dash plates, water space, and steam space, all of which affect the possibility of violently boiling water reaching the steam exit. Priming, as thus defined, is a matter of boiler design and operation.

Foaming is the formation of bubbles upon and above the surface of the water. The less easily these bubbles break, the higher will the foam rise. It may become so excessive that the bubbles, or films of water enclosing steam, pass out with the steam.

Naturally, priming, or a tendency to prime, is an important factor in excessive foaming. Aside from this, the difficulty with which the steam pushes through the surface film of water and separates from it is a controlling agency. With pure water foaming is very slight and never sufficient to cause the loss of water with steam in a well designed boiler. Nearly all impurities dissolved or suspended in water increase the foaming tendency though no two substances may do so to the same degree. As steam is used from the boiler the impurities are concentrated and finally a stage is reached which will cause excessive foaming. If, therefore, the quantity of impurities and the effect of each were known, the calculation of the foaming tendency of a water would be a simple matter. Unfortunately, our knowledge of this department of boiler physics is very slight. It is practically impossible to determine the quantity of suspended matter in a boiler at any time. Suspended matter originally present in the water is largely precipitated, while additional suspended matter is derived from loosened scale and from the precipitation of impurities in solution in the feed water. Organic matter holds a similar indefinite place in connection with foaming calculations because a large but unknown proportion is precipitated. It is, however, usually present in relatively small amount in boiler waters. Although both these classes of substances are undoubtedly important, their role in inducing foaming cannot, therefore, be calculated from an analysis of boiler feed water. For this reason and because all other dissolved substances are relatively insignificant in amount in a highly concentrated boiler water it is generally customary to attribute foaming to sodium and potassium salts. These substances are highly soluble and their relative importance in different waters is easily determined from analyses. The expression $2.7\ Na + 2\ K$ will represent these salts generally within 5% and always within 15%. It will correspond very closely to the "non-incrusting solids" usually estimated from hypothetical combinations and is sufficiently accurate for practical use. Since these compounds are at best a rough approximation of the foaming tendency of a water, nothing would be gained by the use of a more cumbersome expression from which they could be more accurately estimated. The following formula may, therefore, be adopted:

(6) Foaming coefficient, $F = 2.7\ Na + 2\ K$.

It is to be hoped that investigation may lead to a better understanding of this phenomenon and hence to a more reliable index to the foaming tendency of waters.

The steam engineer is interested more in the number of hours his boiler may be run under ordinary load without danger of foaming than in the coefficient given above. This is really a combined index of priming and foaming and may be calculated from the formula:

(6a) Run in hours:

$$Rf = \frac{a}{b}\left(\frac{c}{F} - 1\right),$$

in which a = water capacity of boiler, b = hourly quantity of feed water used, F = foaming coefficient, and c is a constant which represents in parts per million the concentration of salts that will cause excessive foaming in the type of boiler under consideration.

The usual remedy for foaming is blowing off a portion of the highly impure water and replacing it with fresh feed water. If a in the foregoing formula be made to represent the amount of water blown off at any time, the expression will indicate the length of time that may with safety elapse before blowing off again.

The following approximate values have been determined for the constant c for various types of boilers and are here adapted from Christie's "Boiler Waters."

Locomotive boiler	2,500 to 3,500
Stirling boiler	4,000 to 5,000
Modern water-tube boiler (such as the Babcock and Wilcox or Heine)	5,000 to 7,000
Horizontal return tubular boiler	8,000 to 10,000
Old style two-flue boiler	17,000

From these figures it appears that the locomotive boiler is the type most likely to give trouble on account of foaming and offers, therefore, a satisfactory basis for an arbitrary classification of waters according to their foaming tendency. A non-foaming water may be defined as one that can be used in a locomotive boiler throughout one week's work without foaming; a semi-foaming water as one that cannot be used so long as a week, but one that will require one complete water change to avoid foaming in a locomotive boiler not oftener than every two days; and a foaming water as one that cannot be used so long as two days in a locomotive boiler without blowing off or changing water to prevent foaming. Accepting these conditions, the following approximate classification of waters will result:

(1) Non-foaming; F not greater than 60.

(2) Semi-foaming; F greater than 60, but not greater than 200.

(3) Foaming; F greater than 200.

CORROSION.—Corrosion of a metal will occur in the presence of water if the metal is capable of replacing any positive ion in the chemical system which the dissolved matter in the water constitutes. The positive ion thus replaced may pass from solution as a precipitate or a gas. In boiler corrosion the metal to be considered is the iron of the boiler. The positive ion which it may replace in the chemical system of dissolved solids is the hydrogen ion, which, when so replaced leaves the chemical system as hydrogen gas. It follows that the amount of the hydrogen ion in the chemical system under boiler conditions is the controlling factor of corrosion. The calculation of this factor can be made with a fair degree of accuracy. Under boiler conditions the dissolved gases are driven out with the steam. Therefore, although some of these substances are prominent corrosive agents when confined they are omitted from consideration here.

The hydrogen ion as determined by analysis is the first item. It may be the cause of corrosion in the cold or under boiler conditions. To this may be added, as a result of the high temperature in a boiler, three molecules of hydrogen ion for each molecule of aluminum ion, two of hydrogen ion for one of iron, and two of hydrogen for one of magnesium. The reactions involved may be represented by the following equations:

$$2\ Al + 3\ H_2O = Al_2O_3 + 6\ H$$
$$Fe + H_2O = FeO + 2\ H$$
$$Mg + H_2O = MgO + 2\ H$$

These reactions probably do not occur in just this way, but they express well-known results. There are other reactions that may cause an increase in the amount of hydrogen ion. While they will not be considered in the calculations which follow, the three given below are of interest as expressing possibilities:

$$2\ Fe + 3\ H_2O = Fe_2O_3 + 6\ H$$
$$3\ Fe + 4\ H_2O = Fe_3O_4 + 8\ H$$
$$SiO_2 + H_2O = SiO_3 + 2\ H$$

In all of these equations, except the last, the hydrogen ion is represented as being brought into the chemical system to replace a positive ion precipitated as an oxide. In the last equation, hydrogen and silicate ions are both brought into the system. In all cases, of course, the equilibrium between positive and negative ions in the system must be maintained.

Opposed to these reactions increasing the amount of hydrogen ion are others tending to decrease it. Thus under boiler conditions each molecule of carbonate radicle may combine with two and each molecule of bicarbonate radicle with one molecule of hydrogen to form water and the gas carbon dioxide. This is illustrated by the following equations:

$$H + HCO_3 = H_2O + CO_2$$
$$2\ H + CO_3 = H_2O + CO_2$$

Thus positive and negative ions leave the chemical system together.

The carbon dioxide so formed will pass off with the steam.

The two sets of phenomena may be combined to represent the residual hydrogen likely to be replaced in the chemical system by iron from the boiler, as follows:

(7) Coefficient of corrosion:

$$C = 1.008\ (RH + RAl + RFe + RMg - RCO_3 - RHCO_3$$
$$= H + .1116Al + .0361Fe + .0828Mg - .0336CO_3 - .0165HCO_3$$

One of the first occurences in a boiler is the precipitation of at least a part of the carbonate and bicarbonate radicles as calcium carbonate. Such precipitate can be acted upon, the calcium ion being returned to the chemical system to replace the hydrogen ion which forms water and carbon dioxide with the carbonate radicle. The extent of such action is not well defined. With a maximum precipitation of calcium carbonate and a minimum action upon the same, the effect of the carbonate and bicarbonate radicles in the above formula may be reduced by 1.008 RCa or .0503 Ca. The foregoing considerations afford an excellent basis for the classification of waters according to their corrosive tendencies. Three classes may be distinguished as follows:

(1) Corrosive. If C be positive, the water will certainly corrode the boiler.

(2) Non-corrosive. If $C + .0503Ca$ be negative, no corrosion will occur on account of the mineral constituents in the water.

(3) Semi-corrosive. If C be negative, but $C + .0503Ca$ be positive, corrosion may or may not occur.

SCALE FORMATION.—The formation of scale and sludge in boilers is the most common effect of the use of impure feed water. This phenomenon is the result of heating the water to a high temperature and concentrating it. The heat reduces the solubility of many of the dissolved substances to such an extent that they leave the chemical system. Concentration may gradually increase the amount of dissolved matter to saturation, after which additional concentration will cause it to pass out of solution. Suspended matter and colloidal matters are also largely deposited within the boiler.

The purest of natural waters, if used in a boiler for a great length of time without cleaning, would produce scale or sludge. As boilers are usually operated, temperatures and concentrations are permitted which result in the precipitation of practically all suspended and colloidal matter; all iron, aluminum, magnesium; and all calcium to the full extent of its ability to combine with carbonate, bicarbonate and sulphate radicles. The iron, aluminum, and magnesium appear in the scale as oxides (magnesium carbonate may be present, but is not likely to be found in quantity in scale from high-pressure boilers), while the calcium may be present as calcium carbonate or calcium sulphate (a hydrated calcium sulphate frequently occurs, but in the modern high-pressure boiler its quantity is sufficiently small to be neglected). Whether these results are caused by a series of reactions or by a single chemical change is of little moment in connection with boiler calculations. The following reactions, therefore, are presented not as formulas for the changes which actually take place, but as equations which express the known results of changes that occur within the boiler:

$$2Al + 3H_2O = Al_2O_3 + 6H$$
$$Fe + H_2O = FeO + 2H$$
$$Mg + H_2O = MgO + 2H$$
$$Ca + CO_3 = CaCO_3$$
$$Ca + 2HCO_3 = CaCO_3 + H_2O + CO_2$$
$$Ca + SO_4 = CaSO_4$$
$$H + HCO_3 = H_2O + CO_2$$
$$2H + CO_3 = H_2O + CO_2$$

The hydrogen ion in the last two equations may include not only the hydrogen ion found by analysis, but also that developed by the first three equations. In other words it is C, the coefficient of corrosion. An estimate of the amount of scale formed is necessarily rather uncertain. The first three reactions may, without great error, be assumed to be practically complete. The division of carbonate and bicarbonate ions between calcium and hydrogen, and the division of the calcium ion between carbonate and sulphate radicles are not definitely known and probably vary with different conditions of boiler operation. On this account it would seem desirable to estimate maximum and minimum values for scale formed by calcium compounds. Formulas were prepared with this in view, but the differences between maximum and minimum values was found to be small in nearly every instance. The use of the necessarily cumbersome formulas was therefore discarded in favor of one which represents a probable average scale forming value. Calculations based upon this formula are relatively simple, and it is believed that they are of as great practical value as the maximum and minimum formulas. In order to conform to common usage the formula is in terms of pounds of scale per 1,000 gals. of water.

(8) Scale (S)
$$= .00833SM + .00833CM + .3RFe + .142RAl + .168RMg + .492RCa$$
$$= .00833SM + .00833CM + .0107Fe + .0157Al + .0138Mg + .0246Ca$$

In this formula the value of RCa used should not be in excess of $RCO_3 + RHCO_3 + RSO_4$. (Ca should not exceed $.60SO_3 + .328HCO_3 + .417SO_4$).

Formula (8) shows the amount of scale and sludge likely to be deposited in a boiler operated under the usual conditions of modern practice and its value will never differ widely from the "total incrusting matter" frequently reported from an estimation of hypothetical combinations of the ions. It is of equal importance to know whether the matter deposited will form a hard scale. The following formula shows in pounds per 1,000 gals. the probable amount of hard-scale forming material in the scale:

(9) Hard Scale (HS)
$$= .00833\ SiO_2 + .168RMg + .567\ (RCl + RSO_4 - RNa - RK)$$
$$= .00833\ SiO_2 + .0138Mg + (.016Cl + .0118SO_4 - .0246Na - .0145K).$$

The value used for the parenthesis of this formula must not exceed RSO_4 or RCa ($.0118SO_4$ or $.0283Ca$ in the second form) nor should it be less than zero.

Dividing the value of formula (9) by the value of formula (8), a factor will be obtained which may be called the coefficient of scale hardness. This factor shows the proportion of the total scale that is likely to form a cement-like substance upon the boiler tubes and is therefore an index to the probable hardness of the scale that will be deposited. Thus:

(10) Coefficient of scale hardness, $H = \frac{HS}{S}$

From formulas 8, 9, and 10, waters may be classed as follows:

(1) Hard Scale: H not more than .25.

(2) Medium Scale: H more than .25 but not more than .5.

(3) Soft Scale: H more than .5.

In addition, the following classification may be used as a prefix to the preceding:

(1) Very little: S not more than 1.

(2) Little: S more than 1 but not more than 2.

(3) Much: S more than 2 but not more than 4.

(4) Very much: S more than 4.

APPLICATIONS.

The foregoing formulas will now be applied to a few analyses, which, for convenience, have been arranged in the form of statement herein suggested.

Below are given the results of calculation of the various formulas presented and classification of the waters in accordance therewith.

The following classification of the waters (including a word and a numerical classification) will result from the foregoing figures:

(A) (15) non-foaming, (— .44 + .11) semi-corrosive, (.59) very little (.20) soft scale.

(B) (21) non-foaming, (+ .42 + 1.23) corrosive, (1.51) little (.37) medium scale.

(C) (130) semi-foaming, (— 1.58 + 1.63) semi-corrosive, (1.84) little (.46) medium scale.

(D) (30) non-foaming, (— .49 — .08) non-corrosive, (.46) very little (.25) soft scale.

(E) (1057) foaming, (— 9.69 — 8.28) non-corrosive), (.94) very little (.23) soft scale.

The effect of suspended matter upon the scale classification of B is of interest. Neglecting the suspended matter, the class would be "very little hard scale."

For detailed comparison or classification of waters, the formulas presented will be found of great value. It is believed that a better general understanding of waters and much practical advantage would result if the analyst were to devote to the foregoing calculations and the resulting classification a portion of the time usually spent in figuring hypothetical combinations.

For those who desire to use the formulas the following notes are of special interest:

(a) The reacting values are necessary only in estimating the error of analyses. All other formulas are presented in dual form so that reacting values may be used or not, as desired. Generally their use will shorten the work of calculation.

(b) The formulas are well adapted to the use of a slide rule or similar calculating machine.

(c) The reacting weights are calculated from the formula: Reacting weight $= \frac{\text{valence}}{\text{molecular weight}}$, using the atomic weights of 1907.

(d) Change from parts per million to pounds per 1,000 gals. is effected by dividing by 120.

(e) The numerical coefficients used in the formulas are the result of the simple mathematical calculations of chemistry. Thus the coefficient 0.26 of formula (3) is derived as follows: It is desired to find the quantity of lime (CaO) that will react with certain substances. The reacting value of this lime must, of course, equal the sum of the reacting values of the substances with which it is to react. The parenthesis of the formula represents this reacting value. The reacting weight of CaO being $\frac{1}{28.05}$, our reacting value for lime must be multiplied by 28.05 to give parts per million of CaO. This must in turn be divided by 120 to give pounds per 1,000 gals. A final division by .90 reduces the expression to terms of lime of 90% purity. Thus $28.05 \times \frac{1}{120} \times \frac{1}{.90} = 0.26$. Other numerical coefficients of the formulas are derived in a similar manner.

CLASSIFICATION OF WATERS BY RESULTS OF ANALYSIS FORMULAS.

	Parts per million.					Reacting values.				
	A	B	C	D	E	A	B	C	D	E
1. Suspended matter	30.	118.	0.0	14.	0.0					
2. Colloidal matter	3.07	9.36	11.23	13.6	10.8					
Silica (SiO_2)	3.0	6.8	11.	11.	6.5					
Iron oxide (Fe_2O_3)	.07	.06	.23	2.6	4.3					
Alumina (Al_2O_3)	....	2.5	....	....	....					
3. Dissolved gas—										
Carbon dioxide (CO_2)	10.	0.0	7.5	....	122.					
4. Dissolved matter—										
Calcium (Ca)	11.	16.	64.	8.3	28.	.55	.80	3.19	.41	1.40
Magnesium (Mg)	2.8	4.2	12.	1.8	12.	.23	.34	.98	.15	.98
Sodium (Na)	4.6	7.9	48.	9.0	380.	.20	.34	2.08	.39	16.76
Potassium (K)	1.1	....	....	3.0	7.0	.03	....	....	.08	.18
Hydrogen (H)	0.00	.08	0.0	0.0	0.0	.00	.08	.00	.00	.00
Sum positive ions						1.01	1.56	6.25	1.03	19.32
Carbonate radicle (CO_3)	0.0	0.0	trace	0.0	238.	.00	.00	.00	.00	7.93
Bicarbonate radicle (HCO_3)	41.	0.0	156.	39.	162.	.67	.00	2.55	.64	2.66
Sulphate radicle (SO_4)	6.8	76.	51.	5.6	145.	.14	1.58	1.06	.12	3.02
Chlorine (Cl)	7.0	2.7	97.	5.8	213.	.20	.08	2.74	.16	6.00
Nitrate radicle (NO_3)	0.0	1.2	0.4	trace	....	.00	.02	.01	.00	....
Sum negative ions						1.01	1.68	6.36	.92	19.61

	A.	B.	C.	D.	E.
1. Error of Analysis, E (%)	0.0	—3.7	+0.9	+5.6	—0.7
2. Soap cost (cts. per 1,000 gals.)	48.	70.	200.	37.	128.
3. Lbs. 90% lime to soften 1,000 gals.	.35	.11	1.01	.21	2.39
4. Lbs. 95% soda ash to soften 1,000 gals.	.06	.57	.75	.00	.00
5. Cost (cts. per 1,000 gals.) of lime and soda ash	.10	.71	1.08	.06	.72
6. Foaming coefficient, F	15.	21.	130.	30.	1,057.
7. Coefficient of corrosion, C	—.44	.42	—1.58	—.49	—9.69
C + .0503 Ca	.11	1.23	1.63	—.08	—8.28
8. Scale, S (lbs. per 1,000 gals.)	.59	1.51	1.84	.46	.94
9. Hard scale, HS (lbs. per 1,000 gals.)	.12	.56	.85	.12	.22
10. Coefficient of scale hardness, H	.20	.37	.46	.25	.23

Analyses B and D seem to be somewhat in error. The errors indicated could be accounted for by the presence of iron and aluminum ions in the one case and by silicate ions in the other. The differences are not great enough, however, to warrant a change in the form of statement. Hence iron, aluminum, and silicon are presumed to be present as oxides in the colloidal state.

COUNT FERDINAND VON ZEPPELIN has established the Zeppelin Limited Liability Co., with $750,000 of the $1,050,000 raised by popular subscription throughout Germany after the recent wrecking of his giant dirigible balloon. The remainder will be invested for the benefit of Count von Zeppelin and his daughter during their lifetime, but will ultimately revert to the company. Count von Zeppelin will be manager of the company.

THE DESIGN OF FRICTION CLUTCHES WITH SPECIAL REFERENCE TO USE ON AUTOMOBILES.*

By HENRY SOUTHER,† M. Am. Soc. M. E.

Clutches of one form or another, if one may judge from the literature on the subject, have been used since the earliest history of the mechanic arts, an important usage dating far back being in connection with wire drawing. It would seem, however, that clutches in general had attracted but little attention in the engineering world until recently when they have been called upon to do the delicate work now required of them in connection with cotton mill machinery, printing presses, electric cranes, power plants and, most recently, with automobiles.

POSITIVE CLUTCHES.—The positive or jaw clutch is necessarily used only where the character of the starting action is immaterial, and if sudden, matters but little. It obviously can be used only where the inertia of the standing or driven parts is relatively small, otherwise materials could not stand the wear and tear.

Modifications of the positive clutch are made in the angles of engagement between the jaws. The least positive form is one where the planes of engagement are inclined backward as regards the direction of motion at an angle of 15°, more or less. The tendency of such a clutch under load is to disengage. It must be held up to its work by an axial pressure, which may be regulated to perform a normal duty, but to slip and disengage when called upon abnormally by some accident or overload.

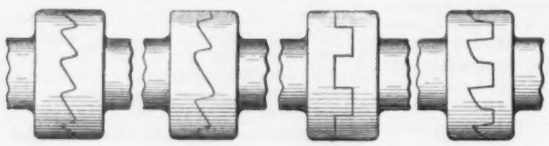


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

TYPES OF POSITIVE CLUTCHES.

Positive clutches with engaging planes parallel to the axis of rotation must be held up to their work to guard against a natural tendency to jar out, but they present no safety features against an overload.

More extreme yet as to positiveness is the so-called undercut engagement of the jaw clutch, the tendency of which is to engage the tighter when loaded; and which can be disengaged only when absolutely free from load and in a condition to be rotated in a reverse direction sufficiently to overcome the under-cut angle.

In automobile construction the positive type of clutch is used inside the gear box, so arranged as to be operated only while the main friction clutch connecting the engine with the driven shaft is disengaged. This positive clutch sometimes takes the form in automobiles of an external spur gear meshing with an internal spur gear. Automobile gear changing systems are used that keep all gears in mesh all the time. Each gear carries a positive jaw clutch to be engaged with mates on the driving shaft, while the main friction clutch is open. Several inventors of merit have accomplished this same thing by a sliding spline (or hardened ball) on the driven shaft, which engages with the gear hub internally. Such forms are in use, but it cannot be said in common use.

It will be seen that this use of a positive clutch in connection with the automobile is one where there is little inertia to be overcome, the mass to be started being only a small shaft within the gear box and the gears on it. The chances are that even these are rotating to some extent in the direction in which they are to continue to move. After this positive clutch is once engaged the main friction clutch comes into play. No drag of the friction clutch is permissible.

The starting crank of an automobile is a first rate illustration of an under-cut positive clutch. It is undercut so that when the hand is applied to the starting crank there is little or no danger of the clutch slipping off and wrenching the operator. It is a fact, however, that some of these clutches are not under-cut and are disagreeable to handle for this reason.

CLASSIFICATION OF FRICTION CLUTCHES.—A rather careful search of the literature reveals the fact that there are basic types, few in number, involved in all clutches, but that there is an infinite variety of detail of construction and manipulation. Rankine differentiates between friction clutches about as follows:

Friction clutch (contracting band),
Friction cones.
Frictional sector (invented by Bodmer),
Friction disk (Weston's invention).

Reuleaux illustrates the Ramsbottom clutch as used for rolling mill work. This is nothing more nor less than a friction coupling in which one flange is squeezed between frictional surfaces by being tightly bolted. Referring to Fig. 5, the flange attached to part A is firmly clamped between the wood-lined surfaces of B, adjustment of the bolts being such that the friction will resist normal torque but yield to abnormal torque. This is perhaps the most simple form of friction clutch.

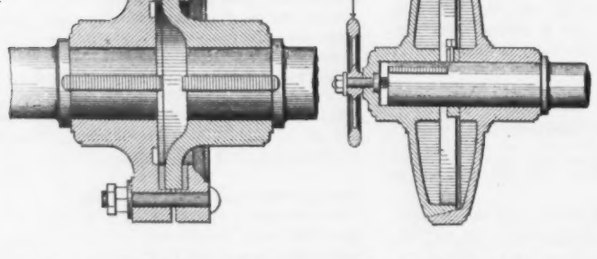


Fig. 5. Ramsbottom Clutch. Fig. 6. Cone Clutch.

It would seem as though some such device might well enter into the transmitting portions of an automobile, so adjusted as to resist up to, say, one-half the elastic limit of the parts involved, and slip under the application of any greater load. Right here it is well to point out, however, that many mechanical devices which have performed well elsewhere have performed badly in automobiles because of the unusually variable conditions to which an automobile is exposed which might prove to be true of this clutch.

Reuleaux then shows as the next step in the development of the clutch a cone coupling, the two parts being forced into engagement by screw and handwheel B, as shown in Fig. 6. He states that the angle of the cone should not be less than 10°, in order that the parts may not become wedged together. He also gives in connection with this clutch with frictional surfaces of iron on iron a coefficient of friction of 0.15. In order to keep the axial pressure within reasonable limits, he places the mean radius of the cone between three and six diameters of the shaft.

Following the single cone clutch in Reuleaux is what might be called a multi-cone, as shown in section by Fig. 7, a series of concentric cone-shaped rings with angles of 10°, or 20° for both halves of the cone. As shown in this cut, it is apparent that the collar would have to resist the pressure and wear due to the axial pressure necessary for proper engagement. This would be serious. Such wear is avoided in heavy machine work or in high-speed automobile design by making the axial pressure self-contained on the rotating member, except when the clutch is in the act of being disengaged. Such construction as this has been found absolutely necessary in connection with all automobile clutches. This modification of the foregoing is shown in Fig. 9. The pressure of the screw [illegible] self-contained, the two halves A and B being [illegible] together by it, the concentric double-faced cone [illegible] ing much friction at slight axial pressure.

The next clutch shown by Reuleaux is that [illegible] h he attributes to Koechlin, Fig. 10. This is of the internal expanding type, three internal clamp pieces, [illegible] with bronze shoes, being thrust out against the [illegible] sing cylindrical drum by means of lever and scr[illegible] action. Reuleaux points out the fact that there is no [illegible] ger of wedging in this clutch, as exists in connection [illegible] the cone clutch.*

Reuleaux next shows a form of "axial fric[illegible] coupling," well known as the Weston clutch, bas[illegible] the principle of multiple plate friction, Fig. 8. The plates are alternately wood and iron, as indicated, the wooden ones engaging with the outside cylindrical containing-case and the iron ones with the shaft. In the form shown, the plates are pressed together by springs and released by drawing back a collar which releases the spring pressure.

MACHINE SHOP CLUTCHES.—The foregoing references to Reuleaux will serve to fix in mind the fundamental or basic types of clutches and I will now give a number of illustrations to show the development of the machine shop clutch from the earlier forms already illustrated. Perhaps the simplest is the type in which one flat disk presses against another, the surfaces being

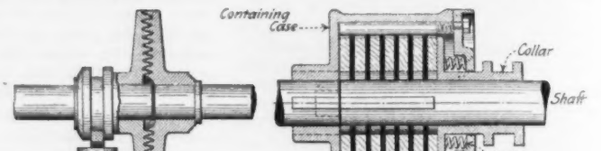


Fig. 7. Multi-Cone Clutch. Fig. 8. Weston Clutch.

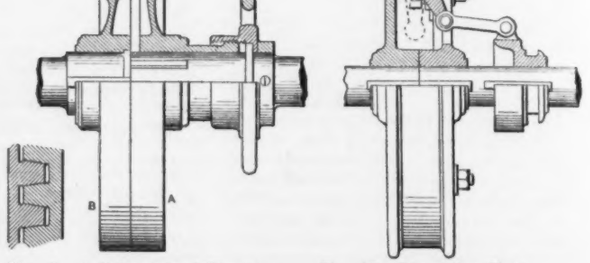


Fig. 9. Self-Contained Thrust. Fig. 10. Expanding Type.

leather against iron, bronze against iron, or wood against iron, the axial pressure being great enough to drive the maximum load, yet not so great but that slipping takes place when the load is first applied, which prevents all jar. Such clutches are familiar in the driving of looms.

In Fig. 11† is a modification of the Weston type. It is not multi-disk, there being only one wooden disk attached to the enclosing case, which is gripped between two iron surfaces, keyed to the driving shaft. To prevent any drag when disengaged, separating springs are supplied, which part the frictional surfaces when idle. Slight rubbing when idle is not a very serious matter in machine shop clutches, however, but its importance in connection with automobile clutches, I will bring out later.

It is interesting to note that very little information is given or obtainable in regard to the frictional capacity of these machine shop clutches. Correspondence with the manufacturers reveals the fact that knowledge of the capacity of their clutches is of an empirical character. The coefficient of friction of maple (which is commonly used by them) on cast iron is known. Little use can be made of this knowledge, however, as the degree of lubrication, or lack of it, may easily double or halve this coefficient. The manufacturers have learned by experience what size clutch of their own make is necessary for the transmission of a given horse-power. Catalogs usually give the horse-power that can be transmitted at 100 r. p. m. It is probable that information

*A paper read before the Detroit meeting of the American Society of Mechanical Engineers, June, 1908.
†Consulting Engineer, Hartford, Conn.

*Bodmer and Koechlin seem to have been working along similar lines.
†Fig. 11 is from the catalog of T. B. Wood's Sons, Chambersburg, Pa.

of this kind, untechnical though it be, is decidedly more reliable than that obtained from any formula containing an unknown variable—the coefficient of friction.

What was formerly known as the Frisby clutch was designed many years ago when no attention was paid to mathematical design, but its capacity has been well established by experience. Fig. 12 shows this clutch, which is not unlike the last one described, except that a flat surface A and cone B are used in combination. The gripping of the surfaces is accomplished in very much the same way. The frictional surfaces are separated by springs when disengaged. It is apparent that this clutch would require less axial pressure for any given horse-power transmitted than the foregoing type because of the cone; or, in other words, for a given axial pressure would transmit more horse-power and therefore would be smaller and more compact, all other things being equal. But here again is the uncertainty of the coefficient of friction. This clutch, for example, might throw its oil to the frictional surfaces more than the previous example, which oil would more than offset the effect of the cone engagement.

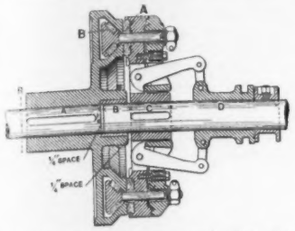


Fig 12. Combined Cone and Flat Surface.

A firm of clutch manufacturers in the West (Dodge Manufacturing Co., Mishawaka, Ind.) have some experimental data upon the capacity of their clutches which are here given. The results were obtained from clutches fitted with maple blocks and calculations are based on a coefficient of friction of 0.37 and a speed of rotation of 100 r. p. m.

Horse-power.	Block area.	Diameter at block inches.	Circumferential pull at block center.	Total pressure.	Total pressure per sq. in.
25	120	16	1,960	5,300	44
32	141	18	2,240	6,000	44½
50	208	21½	2,900	7,800	37½
98	280	27½	4,500	12,200	43½

A modern adaptation of the old Koechlin form of internal expanding clutch is shown in the following cuts, Figs. 13 and 14 (from catalog of the A. & F. Brown Company, Elizabethport, N. J.) These are largely used for very heavy work, the firm advertising clutches 48 ins. in diameter capable of transmitting 320 HP. at 100 r. p. m. The frictional surfaces are wood, especially prepared for the purpose, against iron; the experts of the company claiming that their experience has shown this combination to be the best. They state that wood against iron is not liable to strike fire, as in cases where both friction surfaces are of iron.

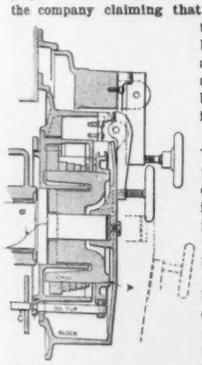


Fig. 15. Clutch for Wire Drawing.

CLUTCHES USED IN WIRE DRAWING.—One of the oldest usages made of clutches, as already stated, is in the wire drawing art. The iron drum around which the wire is wrapped as a rule contains some form of clutch within it. What I believe to be the most recent development in this direction is from a prominent Eastern engineering firm (Morgan Construction Company, Worcester, Mass.). The clutch developed by them is a compound one, the main driving effort being furnished by a wrapping coil on a chilled iron surface, the initial engagement of the coil being brought about by a modified cone or ring slipping down onto a cone which drags the free end of the coil into engagement. Once seized, the wrapping continues until tight. In Fig. 15 A is the tapered friction surface of the chilled drum on which the friction ring bears and below is the coil which is submerged in oil in an annular oil chamber. The drum is 12 ins. diam. × 7 ins. high and the coil, which is of soft steel, is 1¼ ins. square at the large, or driving end and ⅝ in. by ⅝ in. at the small end. The outside diameter of the block is 25 ins.

The importance of starting wire into a die gradually and smoothly is very great. I quote from a communication received from the manufacturers of this clutch, which so fully describes the qualities and action of it as to make it a valuable contribution:

Electrically operated wire drawing machines in England have demonstrated that if wire can once be put into motion and the speed increased gradually to prevent breaking the wire, the possible speed of the drawing is almost unlimited. The wire upon which all the work is done becomes exceedingly hot, but the dies remain quite cool.

In order to test the power of our block, we keyed the hub onto the shaft. This hub was flattened on one side. On this flat surface we strapped an 8-in. I-beam about 14 ft. long, and at a distance of 12 ft. 6 in. from the center of the driving shaft we strapped a gear onto this I-beam in which we could put small weights. We first wrapped a ½-in. annealed crane chain around the block, fastening one end to the block and one to the machine, with a weight of 500 lbs. at a distance of 12 ft. 6 ins. from the center of the driving shaft. The chain broke with a clear fracture. All the links of this chain were strained beyond the elastic limit.

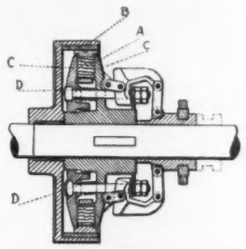


Fig. 11. Modification of Weston Type.

A—wooden disk. C—iron face
B—case. D—separating spring.

We next took a ¾-in. chain and fastened it in the same manner and added weight up to 600 lbs., including the weight of the beam at a radius of 12 ft. 6 ins. from the center of the shaft. At this point the cast-iron quill which had a bevel gear connected at one end and the chilled friction drum at the other end ruptured, the crack extending from the top of the flange down the spindle a distance of 16 ins. in a spiral of 1½ revolutions, as shown at B, Fig. 15, the fracture showing clean, close-grained iron. This cast-iron quill was 5-in. diam. and cast around a rough turned shaft 2 3/16-ins. diam. It had a flange at the top 8¼ ins. diam. × 1¼ ins. thick.

This was the extent to which we carried out experiments and under the above conditions the friction clutch did not slip after it had taken hold. The following calculation gives the pounds pull exerted on the chain:

$$\frac{600 \times 150 \times 49}{22 \times 12\frac{1}{2}} = 16{,}036 \text{ lbs. (more or less)}$$

The pull exerted on the large end of the coil would be equal to

$$\frac{16{,}036 \times 12\frac{1}{2}}{6} = 32{,}761 \text{ lbs. (more or less)}$$

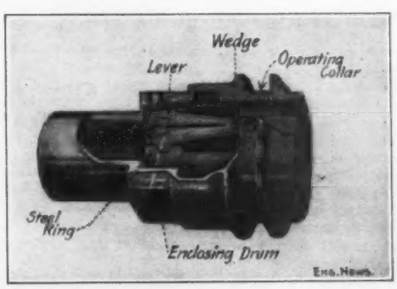


Fig. 16. Example of Clutch of Small Diameter.

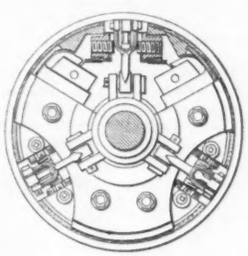
The horse-power of the clutch at 100 r. p. m. under the above conditions would be

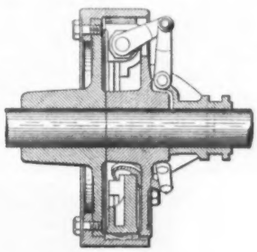
$$\frac{32{,}761 \times 3.1416 \times 100}{33{,}000} = 302 \text{ HP.}$$

A clutch of this kind has been in service some two years, drawing spring wire largely. No repairs or adjustments have been made during that time. The one commercial objection to it is its considerable cost, but it is expected that its good behavior will more than offset that.

CLUTCH OF SMALL DIMENSIONS.—A strong demand has developed for a clutch of very small dimensions for a given capacity. This demand has been met in rather a curious way. Instead of cast iron or metal of ordinary strength, hardened tool steel frictional parts have been resorted to. This permits exceedingly high normal pressures between the frictional surfaces. Fig. 16 gives a very good idea of this form of clutch. It will be seen by inspection that the operating collar forces a wedge between the long arms of two levers, spreading them in such a manner as to expand a hardened steel ring against the hardened steel enclosing drum. As much as 100 HP. has been transmitted at 1,000 r. p. m. with a clutch containing friction rings 5¼ ins. in diameter and 1½ ins. wide. This form of clutch has been largely introduced into automatic machines, machine shop countershafts and launch engines. Its engagement is apparently soft enough for any of these purposes, but in connection with automobile service it is yet in the experimental stage.

CLUTCHES WITH CORK FRICTION SURFACES.—In connection with the commercial clutches of the forms now under discussion, cork has recently entered the field to a considerable extent and apparently with considerable success. It has a high coefficient of friction, probably double that of wood or leather on iron. Its behavior is peculiar because of its elasticity under compression.





Figs. 13 and 14. Modern Adaptation of Koechlin Clutch.

As a rule the corks are forced into suitable cavities formed for them in one of the metallic frictional surfaces. The corks are previously boiled and thereby softened and then pressed into the cavities. So established in a metal surface they normally protrude above the surrounding surface and engage first when the surfaces are brought together. If sufficient pressure is applied to the clutch they are forced down flush with the metal surface and act with it in carrying the load. Following the release of the load they again protrude beyond the surrounding metal surface.

Two forms of cork are used, one being the cork in its natural condition, the other prepared as follows: Small pieces are compressed into sheets and blocks of any desired shape under very great pressure and under enough heat to cause the natural gums of the cork to exude and act as a binder. This form of prepared cork is really more enduring than the natural, being stronger, firmer and yet possessing much elasticity. It is expensive and has not had wide use for this reason. Nevertheless, it has been most successful in performing service beyond the capacity of other materials. That is, a clutch with cork friction surfaces will carry a greater load than a clutch of the same size of ordinary materials.

One example of this I will give, as follows: A Dodge friction clutch carrying 500 HP. gave much trouble on account of being overloaded. This clutch was strained up as tight as possible and it was all a man could do to throw it. The maple blocks used were replaced with compressed cork. It was then possible to loosen the adjustment of the clutch to such an extent that the operator could throw it with little effort. Following this change it was found that a set of cork blocks outlasted the maple ones five to one.

Prof. I. N. Hollis of Harvard University has determined the coefficient of friction of cork on metal. He found that the coefficient of friction for plain cast iron on cast iron is about 0.16; that is, where W represents the pressure on the surfaces and R the frictional resistance, $R = 0.16\ W$. Similarly, for plain bronze on cast iron the coefficient of friction is 0.14, or $R = 0.14\ W$. The coefficient of friction of the cork on the cast iron, however, was found to be from 0.33 to 0.37, the former, 0.33, being the value for the heavier loads. It is apparent that the coefficient of cork on iron or steel is about double that of iron on iron. It is further claimed that the coefficient of friction for cork is not very much less when lubricated. Cork has much advantage in a moist atmosphere, being very slightly affected by moisture, as compared with maple blocks ordinarily used.

Other tests have been made by Prof. C. M. Allen of the Worcester Polytechnic Institute in connection with loom clutches. His results show for a given dimension of clutch a torque for cork inserts nearly double that of a leather faced clutch.

AUTOMOBILE CLUTCHES.—Soon after 1895 the evolution of the automobile or motor vehicle commenced in earnest. There was no difficulty in the way of operating the vehicle with steam or electricity. Positive connection between motor and wheels was quite possible

COMPARATIVE TESTS OF LOOM CLUTCHES.
From Average Results of Eight Positions.

Pressure on clutch pounds.	TORQUE —Measured in Pounds Feet— No. 1 "compo" clutch with cork inserts.	No. 2 leather-faced clutch.
89.5	19.50	16.95
151.5	34.20	17.66
213.0	46.43	23.06
275.0	57.05	29.46
337.0	73.33	36.09
398.0	82.24	41.31
460.0	96.48	47.56

because of the flexibility of the motor. It was realized, however, that these were not the most desirable sources of power. The gas engine in its stationary forms was available. Starting as it does with an explosive impulse, direct connection with the wheels of a vehicle was entirely out of the question. Consequently, a motor vehicle with a gas engine for prime mover was impossible without some means by which the motor and wheels could be separated during the starting of the motor.

In May, 1879, Geo. B. Selden applied for a patent on a road engine in the United States Patent Office. His application incorporated the use of a clutch interposed between the engine and the gearing, so as to admit of running the engine while the carriage remained stationary. This is certainly one of the early recognitions of clutch importance in automobile construction.

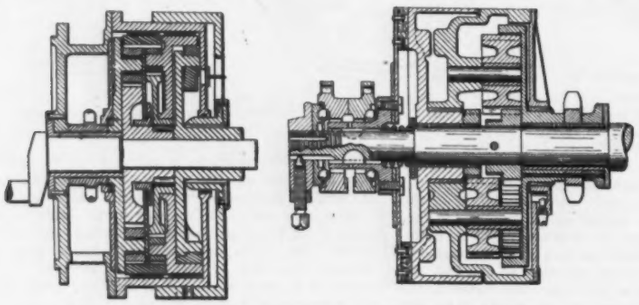
There is little doubt that the appearance of the motor vehicle as a commercial proposition was much delayed by the realization of those skilled in the mechanical art that a good flexible clutch would be difficult to obtain for this purpose. Even at the present time the clutch is as much under discussion among experts in automobile construction as any other element of the automobile. Theory does not enter into automobile clutch construction to any great extent. References that I have found are contradictory. The theory has been worked out for automobile clutches. I found yards of figures and formulae in some of the German technical papers, also in some of the French automobile journals. The question in my mind is whether this is of any practical use in view of the uncertainty of the coefficient of friction involved. Empirical knowledge seems to be all that is necessary.

Perhaps the simplest form of clutch that will be found is that commonly used for small machines and in connection with the planetary system of gear change. This is the pressing of one disk against another, the frictional surfaces being leather, bronze or copper against iron or steel. This form of clutch, Fig. 17, is a very good one as far as it goes, the engagement being soft and gradual. Nevertheless, it is open to very serious objections. If it is so adjusted as to be soft and to pick up its load gradually, a small amount of oil coming between the surfaces renders it absolutely useless. Such a clutch when reasonably dry will drive a car up a grade sufficient to stall the engine. The same clutch with an over-dose of oil will not drive the car up a half per cent. grade on asphalt. This is a good illustration of the uncertainty of figures in connection with clutch design, as far as frictional capacity is concerned.

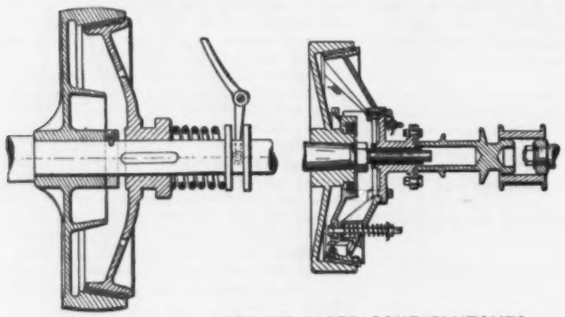
Another form of this same kind of clutch in use in a most successful single cylinder automobile is shown by Fig. 18. I have been able to get the dimensions of this and an idea of the axial pressure necessary, viz.:

Maximum radius of leather frictional surface..$4^{11}/_{16}$ in.
Minimum radius of leather frictional surface..$3^{15}/_{16}$ in.
Mean radius of leather frictional surface.....$4^{3}/_{16}$ in.
Area of leather frictional surface.....36½ sq. in.
Axial pressure, from.....1,000 to 1,200 lbs.
Capacity { Horse-power at 600 r. p. m.....5½ HP.
{ Horse-power at 1,400 r. p. m.....10 HP.

The axial pressure in connection with such clutches is usually furnished by a spring disk; that is, the steel plate which carries the frictional surface, either leather or copper, is caused to operate like a diaphragm spring. The amount of normal surface pressure is not known in most cases as far as I have been able to learn. The above figures in this regard were furnished by the Cadillac Motor Car Company, of Detroit. The diameter of a clutch of this kind ordinarily used to propel a car of 7 HP. or 8 HP. is from 5 ins. to 10 ins., the rubbing surfaces being about from one-half to three-quarters of the entire superficial area of the disk. Such clutches are mostly available for two-speed cars, the disk clutch connecting with the engine direct and running at engine speed, the planetary system being used only for low speed and reverse work, actuated by contracting band clutches.



FIGS. 17 AND 18. TYPES OF PLANETARY CLUTCHES.



FIGS. 21 AND 22. LEATHER-FACED CONE CLUTCHES.

Motor vehicles so geared have their uses, but early in the development it was found that three or four speeds were desirable. Boxes of sliding or change gears were resorted to, and here the character of the clutch became of prime importance. To be satisfactory, an automobile clutch used in this manner must engage and disengage easily, requiring but small axial movement of the operating mechanism, or of the clutch itself. It must be entirely independent of centrifugal force, and able to slip for a reasonable length of time without being destroyed.

The matter of absolute disengagement is perhaps the most important. Without it the sliding gears intended to be operated when the clutch is free or disengaged cannot be unmeshed nor remeshed. The slightest drag or friction in the clutch means a savage clashing of gears when changed. This means the destruction of the gears and the failure of the entire system of gear change. The early history of the art is full of failures in the matter of successful construction and operation of the so-called sliding-gear transmission. Gears with the teeth worn away were the rule rather than the exception. This wearing was, no doubt, due to the imperfect disengagement of the clutch.

The use of a system of gear change requiring the clashing of moving gears cannot receive the complete approval of the engineering world; yet this system has become a success by a combination of improvements in clutch and materials of which the gears are made, and treatment of the materials.

An important feature in the clutch is the question of its weight, especially as affecting its inertia. A clutch having high fly-wheel effect spins to such an extent as to cause violent clashing of idle gears. Consequently, clutches are made as light as possible, and the smaller in diameter the better. Aluminum enters largely into clutch construction for this reason.

The spinning of the clutch has been met in many automobiles by a so-called clutch brake—a retarding finger which operates in connection with the clutch disengaging lever and bears upon some portion of the driven member of the clutch, braking it to a standstill. One inventor has gone still farther in this direction and disengages the driven shaft both before and behind the gear box. This invention is such that the friction clutch opens first, immediately followed by the opening of a positive jaw clutch behind the gears and then the braking of this disconnected driving shaft, as just described. This permits the engagement of gears that are absolutely free and stationary. It may be well to bring out the fact, however, that this invention is open to one objection, and that is that the gears may stop in such a position as to make it difficult to mesh them.

Any automobile clutch must engage smoothly and absolutely without shock to be called a success. The quicker it seizes without shock the better it is. Clutches exist that can be engaged suddenly and still not jar the passengers. But such a clutch is open to one very serious objection; that of not picking up the load quickly enough on a hill to start the car forward after a change of gears, before the momentum of the car is materially lessened. For example, in changing from the high gear to the next lower on a steep hill, a clutch that is too soft will permit the speed and momentum of the car to drop to such an extent that when the clutch finally does take hold the car is nearly at a standstill. This necessitates a further drop into a lower gear; one that will start a car from a standstill on a hill. The clutch designer is, therefore, between two fires; too little slip on one hand and too much slip on the other. A degree of slip between the two must be found, and once found be capable of being maintained. It is doubtful if such a problem exists in connection with clutches anywhere else in the mechanical art.

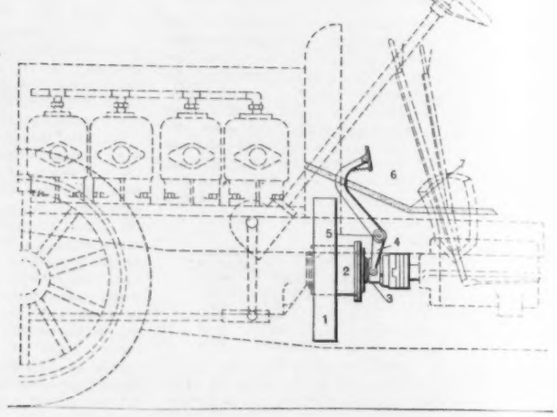


FIG. 19. LOCATION OF AUTOMOBILE CLUTCH.

Fig. 20. Spring Arrangement.

The customary location for an automobile clutch is fairly shown by Fig. 19, that is, within the flywheel or at least at the rear end of the engine if the flywheel is at the front end.

This figure shows the application of the multiple disk type with very little room between the gear box and the clutch, and only an Oldham coupling to give flexibility. This would be too close construction (as will be shown later) for the application of the cone type of clutch, which requires so much flexibility back of the clutch. This illustration gives, however, a very clear idea of automobile clutch location in general, and the numbered parts are as follows: 1, flywheel; 2, cylinder enclosing clutch; 3, clutch shifting collar; 4, lever operating sliding collar; 5, engine base; 6, foot pedal; 7, floor boards.

THE CONE CLUTCH.—I will take up the simplest form first, namely, the cone. I am pretty well satisfied, that, all things considered, it is the best form when properly

designed and mounted. It has the advantage of engaging and disengaging with very small axial motion. Axial pressure may be low because the normal pressure between frictional surfaces is multiplied by the angularity of the cone. Its weight may be very small, as the male member may be of aluminum. Its engagement is entirely independent of speed and centrifugal force. No liquid lubricant is needed with attending viscosity, drag and change due to wear and temperature. Disengagement may, therefore, be made perfect.

Proper engagement, however, has proven to be a very difficult and baffling problem. I think it safe to say that this difficulty has caused nearly all the rejections that have occurred of the cone clutch. A cone clutch may operate almost as savagely as a positive jaw clutch. It may also refuse to engage, if it does not have the proper combination of angularity, pressure and lubrication. It may behave well at times and very badly at other times. A cone clutch of given angles and dimensions, with a definite axial pressure, may be a success in one car and an absolute failure in another. The cause of this contradictory behavior may not be and often is not in the clutch proper; but, on the contrary, in the surrounding mechanism of the clutch. The cone clutch must be absolutely free to center itself and seat

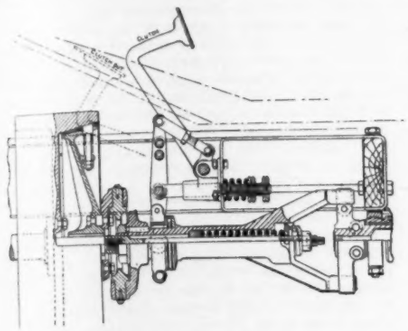


Fig. 23. Cone Clutch for 50-HP. Automobile.

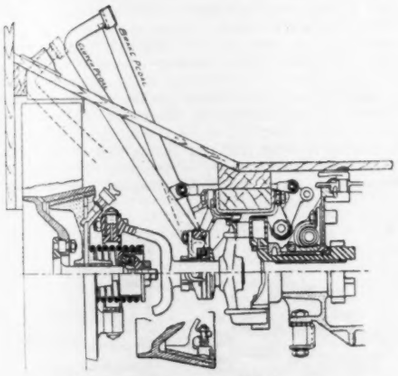


Fig. 24. Clutch of Small Dimensions for 30-HP. Car.

itself uniformly. A short Oldham coupling or a single universal joint between the clutch and the driven shaft of the car is not enough to permit this under all conditions.

The weaving of the frame of the car puts cross strains on such a coupling, causing it to bind and causing the clutch to seize on one side before the other and be drawn suddenly into full contact. A change of angle, increased lubrication and a change of materials on the friction surface will not remove the trouble arising from this cause. A pair of generous, free working, universal joints must be provided, in order that the cone shall reach its seat as intended. Similarly, an engine mounted on a flexible sub-frame or pan support may move sufficiently to prevent the proper seating of the cone and cause a similar line of troubles. The male member must be mounted so as to be flexible enough to follow such small movements.

Experience has been a long time in teaching engineers that so much trouble can arise from apparently so small a cause; yet there are cases where misbehaving clutches have become well-nigh perfect clutches by the introduction of flexible couplings.

Leather (riveted onto an aluminum cone) usually forms one of the rubbing surfaces and gray cast iron the other. It is desirable that the leather shall be kept soft by neatsfoot or castor oil. Some builders boil the leather in tallow before applying to the clutch surface; others do not, but this matter is of minor importance compared with the mounting. With leather ¼ in. to ⅜ in. thick, properly softened, engagement may be sufficiently mild, but an improvement is obtained by placing under the leather at six or eight points on the periphery of the cone flat or spiral springs that cause the leather to engage at these points a little bit before engaging elsewhere.

In "La France Automobile" I find reference to an unusual arrangement of springs underneath the leather of a cone clutch. It is shown very plainly by Fig. 20. It is apparent that the metal of the cone is entirely cut away for a short section, admitting a flat spring not more than an inch wide. The unusual feature is the use of a pair of spiral springs supporting the two ends of the more or less flexible flat spring. I have not seen this construction in use but it ought to be a particularly good way of accomplishing this object.

In some instances rubber buffers have been used under the leather in place of springs. The other frictional surface bearing against the leather is, as a rule, a cast-iron flywheel.

It is obvious that the construction surrounding the clutch must be such that by no means can an unusual supply of lubricant find its way to the frictional surfaces of the clutch. The flywheel prevents any oil

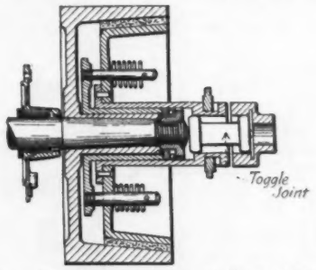


Fig. 25. Early Forms of Cone Clutch.

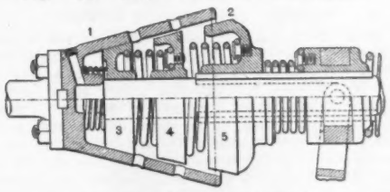
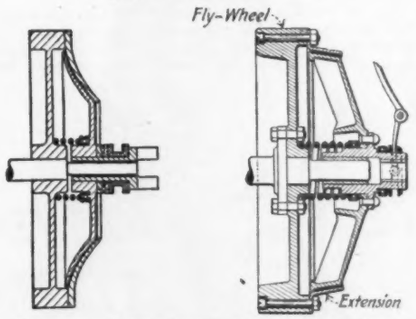


Fig. 26. Multi-Cone Clutch.



Figs. 27 and 28. Modifications of Cone Clutch.

from the engine working its way back, being provided with oil trap grooves for that purpose if necessary.

From the other direction, the gear-box, for example, oil ordinarily does not get as far as the clutch. There is usually a considerable space between the clutch and gear box. In general, it may be stated that the cone clutch is as free from variations due to lubricants as any other. The leather surfaces gradually become dry and hard, requiring the application of castor or neatsfoot oil preferably, but not very often. With proper usage, cone clutches with leather faces seem to last indefinitely. I have accurate knowledge of cars that have surely been driven 20,000 or 30,000 miles without replacement of leather on the cone face. My own experience is confirmatory of this. I have driven several cars with cone clutches and have yet to experience any trouble from the wearing of the leather face. I recently saw a clutch that had been used for about 2,500 miles by me that gave no evidence of wear, neither had it received any attention on my part, except to dose it a few times with neatsfoot oil.

There is one defect in the operation of the cone clutch that has caused considerable trouble. The clutch necessarily requires some end or axial motion and a slip-joint that will permit it. An ordinary square slip-shaft has been commonly used. Instances have been found where these square slip-shafts have jammed under load and seized, so as to refuse to permit of the disengagement of the clutch at critical moments. This is a very serious objection, and one that has not been altogether satisfactorily overcome. Improved materials, increased dimensions and better facilities for lubrication have cured much of the trouble. Generous feathers and splines have been resorted to, which present working surfaces that are normal to each other and which avoid any cam-like or wedging action which may exist with a square shaft bearing in a reasonably easy fitting square hole. Here, again, the perfect freedom introduced by double universal joints plays an important part, the square shaft being very much less apt to bind when perfectly free to center itself.

There has been a considerable variety of opinion as to the proper cone angle. Various authorities have placed it all the way from 7° to 20°. The French have settled down on an 8° to 9° angle as being about right for a leather-faced cone. Several important American makers are using 12° to 13°, several 10° and others 8°.

The accompanying table gives the dimensions for cone clutches used on three different models which are probably as successful as any:

The metal-to-metal cone clutch is a good one. It may be made smaller in diameter and with a sharper angle, say, 7°, without seizing. It may be used in connection with copious lubrication. This form has been and is used only to a small extent. The dividing line between slipping and seizing is narrow.

Another form of cone clutch has an aluminum male member of about 12° angle bearing against cast iron and with cork inserts in the face of the male member. This clutch is not easily affected by a lubricant and, in fact, may be run with copious lubrication. This type has not been widely enough used yet to give sufficient knowledge as to the possibility of general application under many varying conditions.

Up to this time I have referred entirely to what may be called a direct-acting cone, one where the male part of the cone moves axially towards the engine. This is well illustrated by Fig. 21, which is about the simplest form of leather-faced cone clutch. Modifications of this are many, Fig. 22 showing a clutch of the same principle, but in place of having one strong actuating spring surrounding its axis, it has three weaker spiral springs nearer the periphery of the male member.

Fig. 23 is a clutch used for a 50-HP. car, with a cone angle of 13°, a diameter of about 16 ins., a total frictional area of about 128 sq. ins., and axial pressure of 375 lbs. resulting from spring. This cut clearly shows a small spiral plunger spring underneath the leather face to make it pick up its load more quietly and smoothly. This cut also shows a form of slip-joint back of the clutch which, although it does fairly good work, is not on the whole as satisfactory as the double-toggle universal joint. It will be noticed that the arms of this joint have been spread as widely as possible, but, at the best, the pressure and binding action is considerable.

In direct contrast to this clutch is the one shown in Fig. 24, where the diameter of the cone is very much less, not to exceed 10 ins. This is a clutch used in connection with a car developing 30 HP., A.L.A.M. rating, and one that has at times developed much higher horse-power on the block—as high as 36 HP. The clutch angle is 13° and the frictional area the first two years this car was built was 86 sq. ins., but this has recently been raised to 96 sq. ins., the spring pressure remaining at 400 lbs. It will be noted at the bottom of this cut that there is a sketch showing the spiral spring plungers underneath the leather.

Fig. 25 shows an early form of cone clutch used about 1902 or 1903 for a car of about 20 HP. This has multi-springs for creating the proper frictional contact and a peculiar form of spring application, simple in the extreme. One of the early forms of toggle joint is also shown. This gave in its day what was considered very good service.

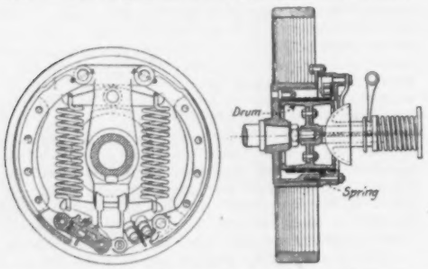
MODIFICATIONS OF THE CONE CLUTCH.—In the "Commercial Motor" for October 31, 1907, p. 218, is shown what may be called a multi-cone clutch. This is seen in Fig. 26. The explanation, to be as simple as possible, is that when the clutch engages, the smallest cone seizes first, commences to revolve and subjects the spiral spring between the next two clutches to torsional movement, which draws them together and brings the two outer cones into action; the idea being that the small clutch shall slip, tend to accelerate the car, that the medium clutch shall behave in a similar manner

TABLE OF DIMENSIONS. THREE SUCCESSFUL MODELS OF CONE CLUTCHES.

Area of flywheel	113.1 sq. ins.	78.7 sq. ins.	73.59 sq. ins.
Angle (one side)	8 degs.	8 degs.	8 degs.
Radius (maximum)	8¼ ins.	8¼ ins.	7⅝ ins.
Spring pressure	375 lbs.	320 lbs.	250 lbs.
Horse-power by A.L.A.M. Formula	48	42	40

three combined pick up the load and move the car. As far as I know, this has not been tried out sufficiently to say whether or not it is a practical success.

I have said that theory did not enter into the clutch very much, but Fig. 27, on p. 361, shows the peculiarity of a simple clutch embodying the tractrix curve. This curve is adopted because it is of such a form that by the figured relation of pressures and peripheral speed, wear ought to take place uniformly at all points regardless of the distance of the point from the center. The claim is made for it that the clearance required to complete the engagement is very small; that there is no wedging action between the two members



Figs. 30 and 31. Modifications of Band Clutches.

of the clutch and that there is no chance for it to bind. Also that it is simple and particularly adaptable to metal-to-metal clutches. It is in effect a flat disk clutch which will not wear faster near its outside edge than near its inside edge, but beyond that I see no gain. It would certainly require very heavy axial spring pressure, just as a flat disk would. The matter of wear is of little moment, either with flat disks or cones.

Fig. 29. Expanding Band.

The so-called inverted cone is well illustrated in Fig. 28. The reversed cone is contained in an extension built onto the flywheel. When the cone is disengaged it moves toward the engine, exactly reversing the action of the foregoing type. This clutch has its adherents, and it is a good one, differing very slightly, if properly assembled, in its efficiency from the direct acting cone. It may be kept free from dirt and oil much more perfectly than in the other form.

A simple formula for calculating the ordinary cone clutch is the following, by Chas. H. Schabinger, taken from "The Horseless Age" of October 2, 1907:

$$hp. = \frac{P f r R}{63{,}000 \sin \theta}$$

P = Assumed pressure of engaging spring in pounds;
f = Coefficient of friction, which in ordinary practice is about 0.25;
r = Mean radius of the cone in inches;
R = Revolutions of the motor per minute;
$\sin \theta$ = Sine of the angle of the clutch.

To obtain the size of spring when the horse-power is known, the following formula may be used with good results:

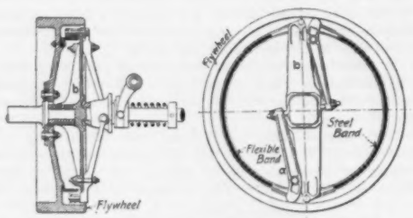
$$P = \frac{hp. \; 63{,}000 \sin \theta}{f \; r \; R}$$

the same symbols being used as in the preceding formula. It will be noted that the coefficient of friction used is 0.25. This is probably near enough for a properly lubricated leather-iron clutch.

EXPANDING BAND CLUTCH.—The next type of clutch may be classified as internal expanding band or ring. This has had many exponents in the automobile art, but is open to centrifugal effects to such an extent that it requires considerable ingenuity to overcome troubles arising therefrom. At high engine speeds the operating levers have in many cases been so arranged as to lower the normal pressure between the frictional surfaces, resulting in a slippage and arbitrarily fixing a maximum limit of speed for the car on the high gear and of horse-power possible to develop in low gear.

Fig. 29 shows a clutch operating on the same principle, driving a 16-HP. car, the spring pull being 50 lbs., the diameter of the clutch about 9.50 ins., and the width of the band 2 ins. This clutch was a particularly soft operating one, but did release at high engine speeds. It operated best with a certain definite quality and quantity of lubricant, which, if varied to any great extent, caused a slipping clutch or a sharply biting clutch. The tendency of the clutch is to unwrap and expand against the enclosing cylinder as soon as any friction is applied to it. The successor of this clutch is shown in Fig. 30, so designed as to overcome the centrifugal releasing effect of levers in the clutch shown in Fig. 29. The total area of the clutch is 36 sq. ins. and the two springs are of 125-lb. tension each. This clutch was a success, but was finally given up in favor of a simple cone.

CONTRACTING BAND CLUTCHES.—The exponents of the contracting band type of clutch are few and far between, unless the contracting spiral be so classed, and perhaps it ought to be. Figs. 32 and 33 show a contracting band characteristic of one of the prominent French cars (Mors). A leather-lined flexible steel band contracts against a steel cylindrical band bolted onto the flywheel. Clutches of this character are seldom found in the automobile industry, except in two-speed cars.



Figs. 32 and 33. Contracting Band Clutches.

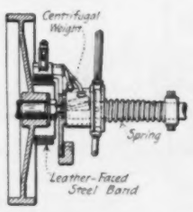


Fig. 34. Wrapping Band.

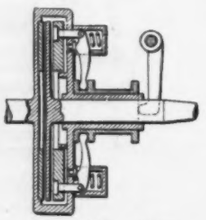


Fig. 35. Single Disk.

About 1897 a single cylinder, 10-HP. car was equipped with such a clutch as shown in Fig. 34, a leather-lined band, very flexible in character, wrapping around the hub of a flywheel and tightened with a spring pressure of about 50 lbs. against a wedge. In this clutch a weight was furnished which would throw out at high speeds and further tend to tighten the band about the hub of the flywheel. The fact that this clutch has not had any successors is an indication that it could not compete with other forms; nevertheless, it was a successful clutch, especially for its time.

Fig. 31 shows a form of clutch that has had prominent adherents. It is the wrapping spiral spring, of either hard or soft metal. The cut indicates the spring in cross section wrapping on the drum. Probably the greatest enemy to this clutch has been the adjustment of the clutching force. With too little lubrication these clutches grip too savagely. With too much lubrication they will not pick up their load rapidly enough. The margin is narrow and hard to control. With a viscous lubricant there is enough drag to make the gears clash badly. The disengagement is not very complete at the best.

DISK CLUTCHES.—The single disk clutch is widely used, both here and abroad. It is so characteristic of a French make as to travel under the name of the firm—the De Dion. It is now used in the country by one firm for horse-powers ranging from 20, for pleasure and for commercial service. The clutch has a disk A, Fig. 35, on the driven member, which is clamped between two disks, C, on the driving member or flywheel. In Fig. 35 this arrangement is clearly shown. There are the necessary accompaniments of separating springs, so as to make disengagement perfect, also either single or multiple springs because the proper engagement.

Fig. 36 shows the same kind of a clutch in a slightly different form. The springs in this case are on the front side of the flywheel rather than on the rear, as in Fig. 35. Cork inserts are being used in this clutch to considerable advantage.

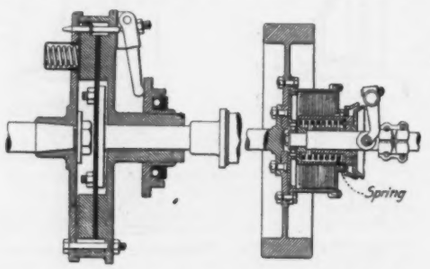
Another form is the now popular multi-disk clutch; that is, the elaboration of the Weston clutch to which I have already referred. This clutch is indicated clearly by Fig. 37, the alternate plates of bronze and steel attached to driving and driven parts being pressed together by a powerful spring.

The question of lubrication here is the all controlling one and, in fact, it would seem that the principal problem in connection with the multi-disk clutch as a type is the proper lubrication of it.

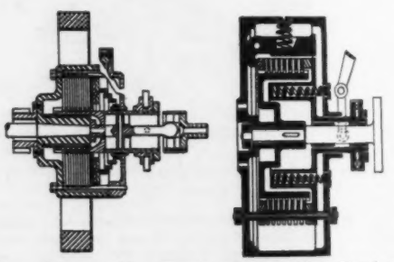
I have ridden in cars equipped with such clutches that were extremely savage in taking hold. I have ridden in others of the same make that were extremely slow to take hold. In a way, this may be a good thing. For example, a person going into a hill climbing contest or race and wishing to pick up quickly would be perfectly willing to put up with a harsh clutch and lubricate accordingly. On the other hand, a car running about a level city, encountering few bad hills, would be able to lubricate excessively and still have a satisfactorily driven automobile. A clutch so lubricated would be extremely soft, and yet pick the car up fast enough for ordinary purposes on level roads.

Cold and heat affect the operation of this clutch, the lubricant in summer being thicker than can be permitted in winter. As it runs in oil it takes a certain length of time for the oil to squeeze out when engaged and for the metal to come in contact with metal and really begin to drive the car. It will be seen from this that the viscosity of the lubricant is of prime importance.

One form of multiple disk clutch in use in a very high grade car consists of steel disks rubbing against a special bronze rolled into sheets. The steel disks are provided with several small tongues on the outer periphery, bent one side sufficiently to come in contact with the next steel disk, for the purpose of separating the disks and overcoming the drag when the clutch is disengaged. A small clutch brake is also provided to overcome clutch inertia or drag inherent in the clutch and due to viscosity of lubricant. The steel disks are put into the clutch as received from the rolling mill, with the hard black finish characteristic of carefully finished crucible sheet steel. This clutch is connected with the crank



Figs. 36 and 37. Types of Disk Clutches.



Figs. 39 and 40. Types of Multi-Disk Clutches.

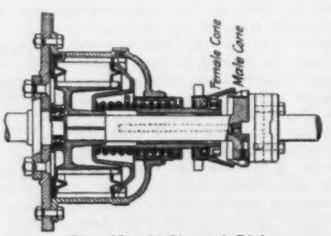
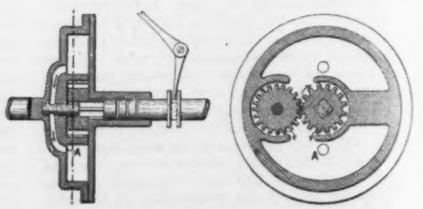


Fig. 42. V-Shaped Disks.



Figs. 46 and 47. Hydraulic Clutch.

case so that oil feeds into it from the crank case through a hole drilled in the center of the crank shaft. Entire reliance, however, is not placed on this supply, a little extra oil being supplied every two or three days through holes provided for that purpose.

Fig. 38 shows a nest of disks such as used in a well-known multi-disk clutch. The U shaped separating springs are plainly visible. These force like disks apart when the spring pressure is released, overcoming the natural tendency of the oil to cause them to

adhere. Some disk clutches are forced apart in a similar manner by little spring shaped strips struck up from the disks themselves.

Another form of this same type of clutch is shown in Fig. 39. Comparatively few disks are used as will be noted. On the other hand, it is apparent that the spring pressure is very heavy. This is a successful and well behaving clutch used on a popular car at the present time. It drags but little when the gears are changed and is satisfactory in that respect.

A type of disk clutch consisting of all steel-disks with alternate ones faced with leather was operated without any oil whatsoever, the leather being softened and made more or less pliable like the leather on the simple cone clutch. These clutches gave some trouble by burning up, the slip required to start smoothly being also sufficient to create enough heat to destroy the leather. This clutch was, however, extremely efficient in the transmission of power. For example, the one shown in Fig. 41, the disks of which are about 7 in. in diameter, was powerful enough to drive an automobile of 50 HP. It must be remembered that the automobile engine runs at high speed, say, 1,000 to 1,200 r.p.m. when developing anywhere near its normal rating. Some motors, in fact, running up as high as 1,500 to 1,800 r. p. m. (standard rating is at 1,000 ft. per minute piston speed).

It is a fact that in service, cars with disk clutches of this character vary more or less in the way their clutches behave. Clutches receive very much less attention than they ought, like everything else on the automobile. I think it will be admitted, even by the adherents of this form of clutch, that it ought to receive more attention than the leather faced cone. Nevertheless, this is now a very successful type of clutch, largely used in many high grade cars.

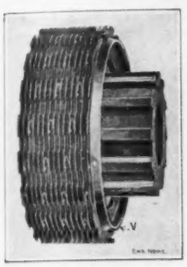


Fig. 38. Multi-Disk Clutch.

In the matter of the number of plates in the disk clutch there is no agreement between designers. Some use a very large number of thin plates, as many as 50 or 60, and others use a very small number, as few as six or eight; in fact, it may be said that the single disk clutch, which has only two frictional surfaces, is the lower limit.

One very ingenious application of the multiple disk clutch has been made by a manufacturing concern in the East (Sturtevant Mill Company, Boston) in the fact that the pressure on the disks is brought about by centrifugal force acting on weights so arranged as to press the tighter with increased velocity. This is shown by Fig. 40. One of the weights at the top of the section, operates against a spring which prevents it flying out and gripping at too low an engine speed. Once, however, this spring pressure is overcome, the disks indicated by the alternately light and dark spaces are pressed together. It would seem that this principle has one serious defect in the fact that at low engine speeds the gripping tendency would be small. It would, therefore, not be possible to develop high torque at low speeds, which is sometimes quite desirable. It is a fact, however, that it is almost impossible to stall an engine by applying this clutch too quickly; it does its own releasing so promptly and automatically.

This principle has been elaborated in connection with an automatic change of gears: gear No. 1 being picked up at a given rate of revolutions by its set of disk clutches; gear No. 2 by an increased number of revolutions by a separate set of disks, and so on. In driving a car so equipped the changes take place without being perceptible except with the closest observation. This system is open to the objection, however, of not being able to spin the engine up very rapidly and connect with the low gear, in order to jump the car out of a hole or some unusual situation. I understand this has been overcome by supplying an independently operated lever for the foot to be used in emergencies only.

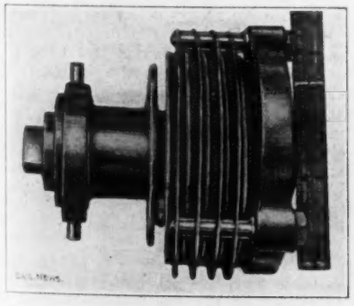


Fig. 41. Multi-Disk Clutch.

With the automatic Sturtevant multi-disk clutch it has been found experimentally that, for the maximum slip speed usual in automobiles, 15 to 20 lbs. per sq. in. pressure is safe, and that lubricated cast-iron disks scarcely wear out the tool marks after many thousands of miles use. They further state that experience has shown them that safe slip is merely a matter of good lubrication and low pressures. They have experimented with small cast-iron disks, running dry and with constant slip at two pounds per square inch pressure, and even at that they wore many weeks transmitting a heavy load. A modification of the multi-disk in which the cone and the disk are combined is attracting much attention. This clutch (Hele-Shaw) is fully described by its inventor in the Transactions of the Institute of Mechanical Engineers (Great Britain), July, 1908. Fig. 38 shows a set, or "pack," of disks from such a clutch. Careful scrutiny reveals a V shaped circular impression struck up in the end disk.

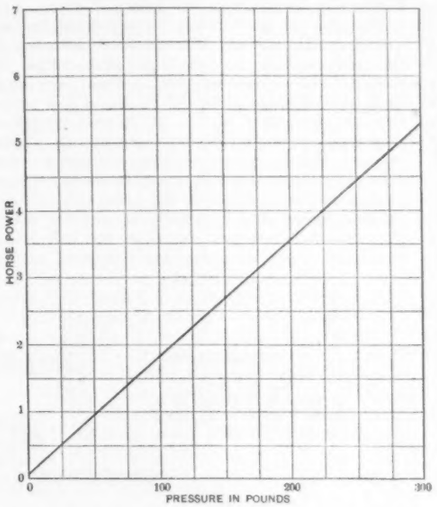


Fig. 43. Power Chart for Hele-Shaw Clutch.

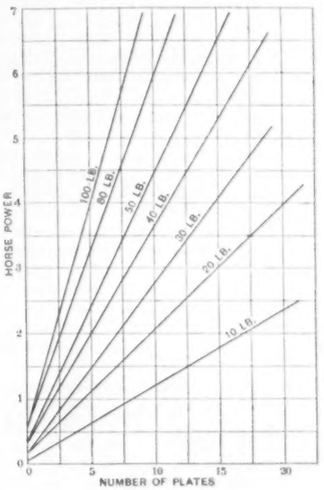


Fig. 44. Chart of Spring Pressures and Horse-Power.

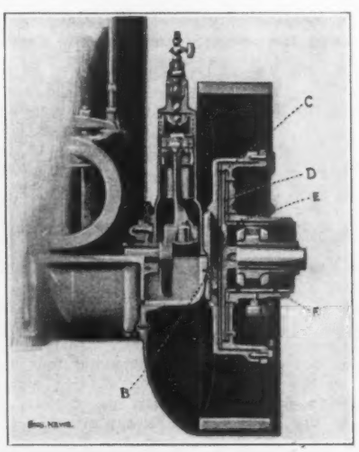


Fig. 45. Air-Operated Clutch.

Fig. 42 also shows the V shape of the disks very well indeed; in fact, the whole clutch is well shown here in section. I call attention to the female cone bearing on the male cone, when the clutch is thrown out, thereby checking the spinning tendency of this clutch, or, if the viscosity of the oil is heavy, holding it quiet during the changing of gears. In place of the entire surface of the disks bearing, only the V portions engage. This clutch is copiously lubricated and the V or engaging portions of the disks are perforated with holes so that the oil may circulate quickly in and out of the V grooves as they are engaged and disengaged. Outside the V portions of these plates or disks there is a comparatively large space between them, permitting the free circulation of oil and consequent rapid carrying away of heat if the clutch slips much.

In connection with the article referred to in the Transactions of the Institute of Mechanical Engineers there are some very good data on power transmitted by various spring pressures, given in Fig. 43. Fig. 44 shows the character of the curve depending upon horsepower and pressure of springs. One-thousand horsepower is being transmitted by one of these clutches running at 700 or 800 r.p.m. and measuring 18 ins. in diameter between the V's in the disks. The following table gives the dimensions and number of plates used for different horsepowers:

	Bronze.	Steel.
25-HP., 27 plates of 6½ in.	14 outer	13 inner
40-HP., 25 plates of 8½ in.	13 outer	12 inner
60-HP., 21 plates of 11 in.	11 outer	10 inner

The space in length required inside of the clutch casing for 25 plates is 5 ins., this including the space for the disengaging movement and the spring pressure plate.

The number of plates in this clutch is made to vary with the power transmitted, the diameters remaining the same within certain limits. The principle involved is that the thickness of the pack of plates shall not exceed the diameter of the plate. When this becomes necessary in order to transmit a load, the plates are increased in diameter, fewer of them being used. The clutch is necessarily heavy, but this is partially offset by the relatively small diameter. It has, consequently, little spinning tendency.

The materials for disk clutches in general have been various, namely, steel on steel, steel on leather faced disks, steel on bronze and steel disks with cork inserts. I have recently been informed of a disk clutch with cork inserts of natural cork that wore out in about 1,000 miles twice in succession. This same clutch was equipped with compressed cork inserts previously described, which have driven the car some 5,000 or 6,000 miles without perceptible wear.

It is a fact that steel disks against steel have become badly heated and cut to such an extent as to make the clutches inoperative. Steel against bronze, however, does not seem to cut in this manner and the wear after two years' steady use is only 0.002 in. or 0.003 in. at the outside edge of the disks. I have not heard of the original combination of Weston, that is wood against iron or steel, being used in connection with automobiles.

The cone clutch stands alone in the great care necessary to so construct it as to permit it to seat itself absolutely concentrically. All the other types of clutches are for the most part free from this difficulty. But it will be seen from the foregoing that the simplicity of the cone fully offsets the extra care necessary in the hanging or assembling of it.

It may seem from what I have said in regard to clutches in general that it is about the worst part of an automobile that can be mentioned, but I hasten to correct this impression if it exists. As a matter of fact, I find reference to the behavior of the clutches in the last Glidden tour, a tremendously severe test of some 1,500 miles. An observer states that the clutches came out of this test quite as well as many parts of the running gear. My own experience is that it is a mighty poor automobile clutch that cannot be neglected and cannot run without any attention whatsoever for 1,000 miles.

A pneumatic clutch has been developed which has not been widely used because of its cost. It is a plain leather-faced disk pressing a metal plate as indicated in Fig. 45. The clutch is located within the flywheel and the air is forced from the pump through a small air

and that when the large clutch comes into play the cushioning tank and from there it enters the clutch through the hollow crank shaft *B* and an air valve. The air deflects the leather diaphragm *C*, causing it to bear against the metal disk *D* which can have a slight endwise motion, and forces it against the fiber disk *E* permanently riveted to the casing *F*, which latter is bolted to the flywheel. The makers, the Northern Motor Car Company, Detroit, give the following in regard to the clutch and its air pump:

The lubrication of the pump became a problem because we did not want the oil thrown into the air clutch, so an opening was left from the base of the pump into the upper part of the crank case, and this air seemed to be sufficiently oily to lubricate the walls of the pump without causing trouble in the air valves. This construction is extremely simple and cheap as far as the air clutch itself is concerned, but as a whole the air clutch is expensive, from the fact that it is necessary to build a very fine air pump and air valves, and conduct the air through tight joints in the piping, and also drill out the crank shaft throughout its entire length in order to admit the air into the clutch, all of which costs much more than a good cone clutch.

Hydraulic clutches have been used but are not popular. Fig. 46 and 47 show one of the simpler forms. The magnetic clutch is in use and is fairly successful. Such clutches are operated on the same principle as the so-called "pick up magnet" found in so many plants. One complication arises in the fact that one of the parts of the magnet has to rotate continuously, the gears being always in mesh; consequently the exciting current has to be carried to it by a brush. These clutches do not heat badly, at least not badly enough to cause any trouble; but they seize rather savagely unless carefully controlled. A considerable current is also necessary on the car for the operation of the clutch. These complications rather interfere with the extended usage.

REINFORCED-CONCRETE PIERS IN BALTIMORE HARBOR.

Since the fire of 1904, the city of Baltimore gradually has been replacing its docks along its so-called "basin" or inner harbor by more modern and durable structures than those which were destroyed or damaged by the conflagration. On the north shore of the basin, eight new docks have been planned. Of these, the westerly three have recently been completed, of timber construction with a masonry bulkhead protection. The next three, to be of reinforced concrete, are now under contract to the Sanford & Brooks Co., and the final two are being designed in the office of the Harbor Engineer. Piers 4-6, of the reinforced-concrete construction now under contract, present many new features of design.*

As is well known, the harbor of Baltimore heretofore has been greatly polluted by the city sewage, but the sewage disposal system now under construction will clean up the waters to a great extent, so great, in fact, that it is expected that the teredo, which now cannot live in the harbor, will be able in future to pursue its peculiar activities in destroying timber in the docks. For this reason, and also to provide a more permanent system of piers, it was decided to build the new docks of reinforced concrete.

*Solid piers with masonry walls and earth filling, at Baltimore, were described and illustrated in our issue of July 10, 1906.

The three piers to be so constructed are to be built for the most part with bulkhead walls, tied together across the pier, and filled between with earth, but in places where the connecting tie is too long for safety in construction and maintenance, piles are driven back of each wall and the walls held against the earth thrust by tie beams running back to the piles.

The type of construction is shown in the accompanying figures. Oblong steel caissons 10 ft. long and 3 ft. wide in plan form the basis of the retaining wall. They are sunk to a hard bottom about 24 ft. below low water and are then filled with a 1:3:5 concrete mixed with as large as 12-in. embedded stones. These caissons, which will hereinafter be called cylinders, are built of sheet steel in 4 ft. × 5/16-in. plates, stiffened every 4 ft. vertically by two circumferential 3 × 3 × 3/8-in. angles and every alternate 4 ft. by one angle of the same size. Vertically the long sides are stiffened in the middle by a line of two similar angles on each inside face. The cylinders are placed 25 ft. c. to c. along the dock face. Connecting the cylinders and acting as a backing for the sheet piling, are lattice girders, with their long plane horizontal, made up of four 6 × 6 × 7/8-in. angles double-laced with 3 × 1/2-in. bars 14 ins. on centers. These girders are 2 ft. 6 ins. deep. They extend through the steel casing of the cylinders into the enclosed concrete, and are for their entire length completely encased in a coating of concrete.

Back of these lattice girders the concrete sheet piling is driven. These sheet piles are 12 × 18 ins. in section and are reinforced with four 3/4-in. square rods on the tension side and four 3/8-in. rods on the compression side, all tied together by 5/16-in. round rod hooping, spaced every vertical 18 ins. These sheet piles retain the earth fill inside the dock, the thrust from which is transmitted through the lattice girders to the cylinders, which are in turn held back either to the cylinder directly opposite on the other side of the pier or to piling driven some 30 ft. back. These ties consist of reinforced-concrete beams 10 × 18 ins. in section and heavily reinforced with rods which run around the lattice girders and are tied to steel pins embedded in the cylinder-encased concrete. When the inside pile anchorage is used, the ties are connected to a 6-ft. anchor beam, of concrete, resting on two reinforced-concrete piles. The construction may be easily understood from the figures. It is probable that fenders not shown in the drawings, will be attached to the cylinders as a protection from the shipping.

The floor of the dock is paved with cobblestone and the outer face, beyond the sheet piles, is carried on a reinforced-concrete slab resting on the outside edge on two 15-in., 45 lbs. channels spanning betwen the cylinders and on the inside on a continuous concrete column resting on the sheet piling.

To the east of the docks, Jones' Falls empties into the harbor and its banks are to be held by docks similar to these described, except that, on account of the heavy masonry facing wall—now in place and to be continued—the lattice girder is to be replaced by a reinforced-concrete beam 2 ft. 2 ins. × 2 ft. 6 ins. and heavily reinforced, as shown in Fig. 2.

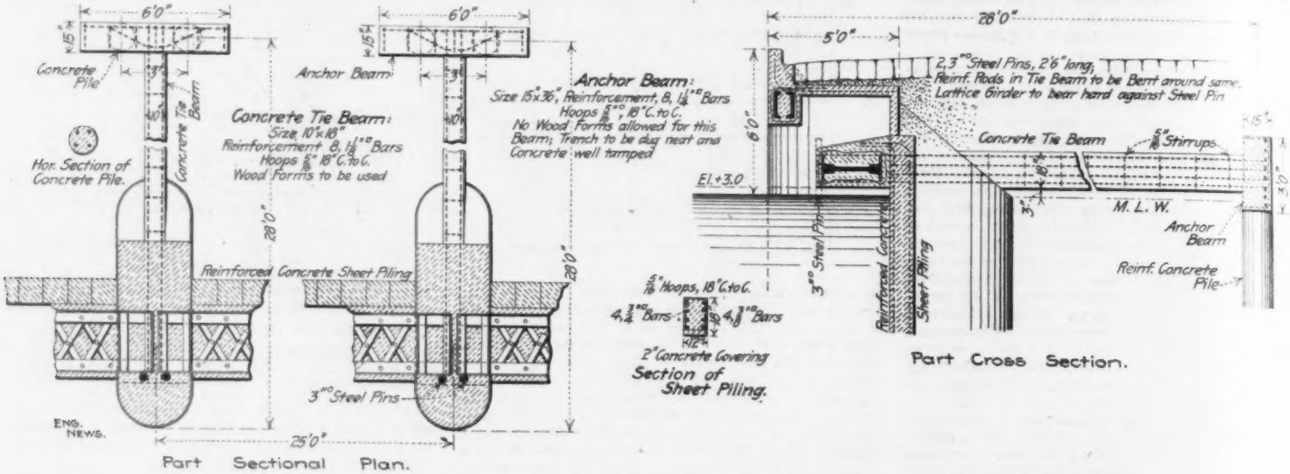


FIG. 1. SECTIONAL PLAN AND ELEVATION OF REINFORCED-CONCRETE PIERS IN BALTIMORE HARBOR.
(Designed and constructed by Mr. Oscar F. Lackey, Harbor Engineer.)

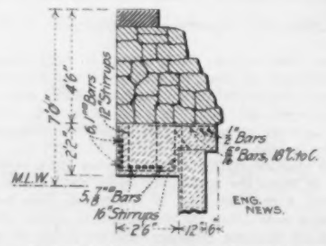


Fig. 2. Cross-Section Showing Special Construction of Reinforced-Concrete Piers in Baltimore Harbor.

In view of the failure of certain timber piers in the harbor at Baltimore the stress conditions on these new reinforced-concrete piers should be of interest. The ground, as found by taking a number of borings, is a combination of sand and coarse gravel at an average of 24 ft., and seems to remain about the same to a depth of 40 ft. Assuming this ground good for 7 tons per sq. ft., the cylinder, with a total area of 28.07 sq. ft., is good for 196 tons direct bearing. The total live load on the floor area resting on the cylinder is about 123.5 tons, which would allow 73 tons for any superstructure which may afterward be put on the dock. The reaction against the sheet piling is figured to be 4,700 lbs. per lin. ft., horizontally, to take up which the lattice girder is designed. The tendency of the cylinder to slip or overturn is, of course, resisted by the beams tied back to the interior piles on the opposite cylinder. The slab floor at the outer edge of the dock is designed to carry a load of 600 lbs. per sq. ft.

This work has been designed in the office of the Harbor Engineer of the city, Mr. Oscar F. Lackey, Assoc. M. Am. Soc. C. E., and the construction is being carried out under his direction. We are indebted to Mr. Lackey for the information and figures here presented.

A SPILLWAY OR OVERFLOW is to be built between the Desplaines River and the Chicago drainage canal, near Willow Springs, Ill. The floods in the river every spring cause a flow from the river through the old Ogden ditch to the Chicago River, and this is sufficient in many cases to reverse the normal flow of the river so that it discharges its sewage-laden water into Lake Michigan. The spillway will cause the Desplaines River to discharge into the drainage canal (during floods), thus preventing the interference with the flow of the Chicago River to that canal.

ANNUAL CONVENTION OF THE NEW ENGLAND WATER WORKS ASSOCIATION.

The twenty-seventh annual convention of the association was held at Atlantic City, N. J., Sept. 23-25. Something over 200 members and guests were in attendance. A number of well-selected papers were presented, on which, as a whole, there was a fair amount of interesting discussion. Little other business came before the association.

At the opening session Mr. John C. Trautwine, Jr., of Philadelphia, outlined water purification at Philadelphia, by the aid of lantern slides. The afternoon of the same day was devoted to the report of the Committee on the Conservation of the Natural Resources of the Country, and two supplementary papers on the same subject. In the evening there was a roller-chair parade on the Boardwalk, followed by an officers' reception. The three sessions on Thursday were devoted to papers and committee reports. On Friday there was a trolley ride in the morning, which included a visit to the water-works pumping station; while the afternoon was left open.

The paper on "The Conservation of Water Resources," by Mr. M. O. Leighton, Chief Hydrographer of the U. S. Geological Survey, was read by Mr. Horatio N. Parker, also of the Survey. Mr. Leighton laid stress on the necessity of considering the water resources of the country as a whole, and not as related to any one of the uses to which they are put. Heretofore, for instance, navigation has generally been considered quite by itself, without regard to the other possible uses of the water of the drainage area in question. Unfortunately the country has not retained public control of its natural waters, which exceed in value any of the other mineral resources of the United States. There is great need of more data on all phases of water-supply, using this term in its broader sense. There is also need of popular education, inasmuch as few people, including those who shape legislation, realize the value of a million gallons of water or a thousand horse-power. It is incumbent upon engineers to educate the public in these particulars.

Floods are primarily a waste of water and should not be regarded merely as possible sources of damage. Our uplands are good for little save the growing of timber and the storage of water, both of which enhance the value of these higher areas for recreation, which is the chief additional purpose which they serve. Once waters are stored, they may be released as needed for city water-supply, for water-power, for navigation and for irrigation.

Mr. R. S. Kellogg, of the U. S. Forest Service, presented a paper on "Forestry." By way of illustrating the enormous magnitude of the lumber industry of the country, Mr. Kellogg stated that the lumber cut of the United States since 1850 would make a boardwalk, 6 ins. thick and 100 ft. wide, from the earth to the moon. He further stated that the value of the lumber cut in Michigan since 1849 was greater than the total production of gold in California since that date. As to the future, he was optimistic, stating as his belief that there is plenty of land better adapted to growing timber than to any other purpose, the sum total of production on which could be made to more than meet the future needs of the country.

The first big thing in forestry in the United States was the establishment of the first National forest reserve, in 1891. At present we have nearly 160,000,000 acres of these reserves. The States of New York and Pennsylvania have some 2,500,000 acres of State forest land. Mr. Kellogg called particular attention to the fact that all the National forest reserves yet established are located west of the Mississippi River, and to the great need of providing without further delay the two proposed Appalachian reserves—one in the White Mountains and another in the South Atlantic States.

Mr. Kellogg's paper gave rise to a quite spirited discusssion as to the relation of forests to rainfall and run-off. Mr. Allen Hazen expressed the opinion that if there was anything in the claim that forests do increase the run-off, it ought to be possible to bring forward evidence to prove it. Mr. Hazen found while in Australia a view to the effect that heavily forested areas were unfavorable to stream yield, and that the trees on thousands of acres had been ring-barked to kill them, with the hope of increasing the run-off. Mr. Hazen's own examination of the data had discovered very little evidence in favor of either the Australian or American theory.

Mr. Morris Knowles stated that the question under discussion at the moment was complicated and could only be answered by a long series of records covering the geological formation of many sections of the country in question, its forestation, rainfall, run-off, etc.

Mr. E. W. Bemis, of Cleveland, O., said that whatever doubt there might be regarding the relation between forests and water-supply, there could be none as to the importance of forestry in relation to the timber supply of the country; and for this and other reasons, every one should uphold the present Government policy as regards extending and protecting the forest area of the country. He added that the limiting conditions governing far-seeing forestry work is one of the stock arguments of some of the economists to prove the falsity of the economic theory of individualism. The individual cannot deal with forestry problems, since commercial returns are beyond the lifetime of the individual. Incidental benefits of forestry work, such as those pertaining to water-supply, do not accrue to the individual, which is another argument in favor of State or National forestry work.

A question having been asked regarding the economic losses due to forest fires, Mr. Kellogg said that reliable figures on this subject were not now available, but that a census will be taken of the forest fires of the United States that have occurred during the present year. He also said that at the United States forest reserves fires are now almost wholly prevented.

On Thursday morning a very interesting paper on the "History of the Haverhill Water-Works" was presented by Mr. Albert L. Sawyer, of Haverhill. These works were built in 1803 by the Proprietors of the Haverhill Aqueduct. Mr. Sawyer read some very interesting and in some cases amusing extracts from the early records of this enterprise. These extracts dealt with a century-o'd contract for supplying and laying wood pipe, and also with the bills rendered by a certain tavern proprietor for rum, flip and other drinkables that seem to have been an essential requirement for a successful meeting of the proprietors.

The city of Haverhill acquired these private works in 1891 and has since operated them under a legislative act which has entrusted the management of the works to a board, as independent as possible of the city government. The aim of the act was to put the works on a strictly business basis. According to its provisions the city was to pay for water used; but after five years the City Council, when put to for money, yielded to the temptation to divert water-works funds to other municipal purposes, as has so often occurred elsewhere.

A novel subject was presented by Mr. R. S. Weston, of Boston, in a brief paper on "Rubber Pipe-Joints." These joints, Mr. Weston found on a recent trip abroad, have been used quite extensively in Germany, in connection with underground supplies, and particularly in jointing suction pipes and also in jointing siphons. The rubber jointing material is made from the best Para rubber, in the form of rings, which themselves are butt-jointed and vulcanized. The rings are slipped over the spigots, and then the whole pipe length is forced forward into the socket by means of a lever, whereupon the rubber ring is flattened and forced home in the joint space of the spigot. There is no bead on the spigot. For sizes up to and including 14 ins., Mr. Weston showed by a table, based on the New England Water-Works Association standards for pipe joints, that rubber joints would be considerably cheaper than the ordinary lead joint, the figures for 4-in. pipe being 63 cts. for lead and 57 cts. for rubber, and for 10-in. pipe $1.41 for lead and $1.08 for rubber. No bell holes are needed where rubber is used for jointing material. If the joint space were made less for the larger sizes, as Mr. Weston thought it might readily be, then the rubber would be cheaper than lead for the larger sizes of pipe. The advantages of this jointing material are that joints made with it are absolutely flexible, no calking is required, the joints resist electrolysis and can be made readily in wet trenches. It should be added that lead is packed in front of the rubber ring after the latter is in place. This jointing material has not yet been used in water-works practice for high pressures. Exposed to air, the rubber absorbs oxygen and loses its elasticity; it is therefore particularly suitable for use on ground-water supplies, where a layer of silt forms on the inside of the ring, which, with the carbonic acid and water, helps to protect the rubber.

Mr. Allen Hazen remarked that he saw rubber joints used in Germany 15 years ago. They were employed on suction mains because they could be made air-tight, while lead could not. References were made by other speakers to the use of rubber rings in Dresser joints for natural gas mains under pressures of 400 to 500 lbs., and to the use of the same material on the compressed-air pipe line at Norwich, Conn. At Norwich rubber rings gave rise to leakage after a year, so the pipe had to be dug up and the clamps screwed tighter. After five years' time, many more leaks occurred. It was pointed out by Mr. Weston that this might be expected from rubber used under such conditions.

Several members told of satisfactory experience with the use of leadite as a jointing material. [See Eng. News, May 21, 1908, for an abstract of a similar discussion giving like satisfactory experience, before the American Water-Works Association.]

A lengthy paper on "Covered Reservoirs" was next presented by Mr. Frank L. Fuller, of Boston. The paper opened with extracts from various reports relating to reasons for covering reservoirs, chiefly the exclusion of light to prevent the growth of green vegetable matter. The author then continued by presenting a table summarizing particulars as to covered reservoirs in New England, of which about 20 have come to his attention. He also described a number of reservoirs of which he had been engineer, and went at some length into the subject of waterproofing. In one case he had lined an old reservoir to prevent leakage, using for this purpose a 4-in. brick wall, with a space of ½-in. between it and the old reservoir wall, this space being filled with coal-tar pitch. Satisfactory results were obtained in this way. The first of the New England covered reservoirs of which he had record was constructed in 1887.

"Meters and Water Consumption of the Hartford Water-Works" was the title of a paper read by Mr. Ermon M. Peck, of Hartford. In 1900 there were only 550 meters and the water consumption was 85 gals. per capita. During the next three years the consumption per capita was reduced to 75 gals., largely by inspection, 10% of the services being metered in 1903. Since the last-named date the consumption has been gradually reduced, until in 1907 it was 59 ga's. At the same time the meters were installed, until now about 99% of all the taps are metered. Inspection work has continued to the present time, however. A 9 × 14-in. card is used for meter records, one side being devoted to installation and the other to maintenance data. These cards are filled out by a billing machine.

In answer to a question from Mr. Hazen, Mr. Peck stated that he did not know the amount of water per capita drawn by manufacturing plants for their own use from other sources than the public water-supply; it was large, but had not been increased by the introduction of meters.

Mr. W. H. Richards, of New London, Conn., sent a paper on "Meter Rates." He opened by saying that few points remained for discussion on an otherwise threadbare subject. Heretofore meters have been considered chiefly as a means of preventing waste, and have served that purpose. Is it not time that they be advocated on the ground of equity? To say that all stores, barber shops, etc., use the same amount of water [as is assumed in the case of the usual schedule for flat-rate charges] is absurd. The charges for water should be based on its cost, and the cost varies in different cities, as should the rates. Mr. Richards presented a table showing the wide variation

in the cost of water in various cities, which variation ranged from less than 2 to over 20 cts. per 1,000 gals. The problem is to find a unit cost for each city that will cover all interest charges, operating expenses and maintenance risks. Before applying this unit rate, the cost of supplying water for fire protection and other municipal purposes should be deducted. The rate should include meter maintenance and replacement, and there should be a minimum charge regardless of the quantity used. Sliding scales, which permit the water consumer to obtain a lower rate by using a larger quantity, should give place to a schedule providing a certain charge for a given quantity of water and a lower charge for consumption above that quantity, and so on.

Mr. Bemis stated that Cleveland now has perhaps more meters in use than any other city, the number being about 68,000. He agreed with the statements in Mr. Richards' paper, except perhaps as regards the graded system of rates. This might be necessary in some cases in order to secure revenue, and there is reason in having a higher rate for very small consumers than for large ones in order to cover the cost of service in the latter case. A minimum rate is also justified; but he did not approve a continually decreasing rate for large consumers, since this makes it possible in these days for the big fish to swallow all the smaller ones. Making this possible, he stated, violated his theory of the function of government. The National Government does not make a lower rate for a large quantity of postage or internal-revenue stamps, nor do governments give discounts to large taxpayers. It might be advisable in some cases to give a special rate to large consumers who would otherwise be lost as patrons, but this should not be done if it discriminates against other consumers. Divergent views were expressed by several speakers on the general subject of what may be termed retail and wholesale meter charges.

Taking up another point in Mr. Richards' paper, Mr. Leonard Metcalf, of Boston, said there seemed to him to be a tendency for municipalities to contribute less rather than more than formerly to the water department for water supplied for fire protection and like purposes. Mr. Metcalf and others in the course of the discussion expressed themselves strongly in favor of having each department pay for the water used. Mr. Bemis stated that while he was heartily in favor of this, it was prohibited by an Ohio statute, so that no municipality in Ohio could collect a cent for water supplied for municipal purposes or charities. In Cleveland, however, the supplies of the various city departments are metered, and this serves to help keep down the waste; in metering the supply to a cemetery, he stated it was found that the occupants were using more water per capita than while they were alive.

A paper entitled "The Water Service and Insurance Rates" was read by Mr. F. A. Barbour, of Boston. Mr. Barbour described the water-works improvements at St. John and at Fredericton, N. B., and also at Attleboro, Mass. Some extracts from this paper are given elsewhere in this issue.

Mr. Hazen remarked, in discussing the paper, that within a few years the question of fire protection would largely solve itself by improved methods in building construction. Meantime, we must take care of the thousands of wooden buildings and be ready to concentrate large quantities of water upon them in case of fire. The more the cost of the fire protection of the extra service necessitated by such problems can be put upon this class of property, the sooner it will be done away with.

Mr. Metcalf stated that it was a pity that city officers did not more generally recognize the desirability of giving needed financial support to the fire-protection end of water departments.

The closing session on Thursday evening was devoted to reports of committees on awards for damages for water diversion, and awards in water-works valuation cases; also, to a paper on "Stream Flow Data" by Mr. Charles E. Chandler, of Norwich, Conn., and a paper on "The Adjustment of Damages for Stream Diversion by Storage Compensation" by Mr. Robert E. Horton, of Albany, N. Y.

The committee on awards for water diversion reported that, although it had collected a considerable amount of information relating to water-power diversion suits, it had decided to send out a list of questions for the purpose of securing still more information, and that along uniform lines. These questions are as follows:

(1) Data of valuation, sale or award.
(2) Amount thereof, exclusive of interest ($).
(3) Total amount, including interest and allowances for collateral items.
(4) Incorporated name of both parties.
(5) Location, town, city, county and State.
(6) Character of privilege.
(7) Total area of watershed taken or diverted.
(8) Amount of watershed taken or diverted.
(9) Amount of water taken or diverted.
(10) Theoretical fall taken to which right was claimed.
(11) Fall used or developed.
(12) Hours per day during which power is used.
(13) Character of development, product of mill, etc.
(14) Character of watershed.
(15) Cost of coal per 2,000 lbs., and of electric current.
(16) Is steam used for manufacturing or other purposes?
(17) Is water used for any other purposes than for power?
(18) Number of wheels installed.
(19) Power of wheels.
(20) Total steam and electric power development.
(21) Total power required to run mill.
(22) If supplementary steam or electricity is necessary, state amount.
(23) What must be done to improve the privilege, or to develop undeveloped available power there and cost thereof.
(24) Approximate area of mill pond.
(25) Approximate depth to which mill pond can be drained.
(26) Are there other storage reservoirs upon the watershed? If so, state capacity.
(27) Character of control of the storage.
(28) What were the controlling factors in the award?
(29) Did the award include any allowances other than for the water or water-power?

The committee has concluded that it is impracticable to follow out the instruction of the resolution under which it was appointed, and "to formulate standard rules for computing and assessing damages for the diversion of water."

In opening his paper, Mr. Horton defined compensation in kind as follows:

. . .regulation of the flow of a stream in such a manner as to compensate for water diverted, by drafts from storage during dry times, in such a manner that the flow of the stream shall never fall below a certain minimum fixed by agreement or adjudication. Such compensation would be furnished in lieu of, or in addition to, money damages for the diversion of water.

He reviewed the few instances of such compensation in this country, and at the close submitted the following conclusions:

(1) Compensation in kind should not be attempted on a stream where the natural low-water flow plus the feasible storage development will not supply more than the total requirement for water-supply and power.
(2) Arbitrary rates of compensation should be avoided. The basis of compensation should be made so flexible as to admit of the best utilization of all the water of the stream in the most economical manner.
(3) Legislation should be secured by which the will of the majority of riparian owners can be enforced in the matter of storage development and stream regulation, and which will prevent a minority of the riparian owners from either blocking a storage or compensation project, or from receiving benefits therefrom for which they do not pay.

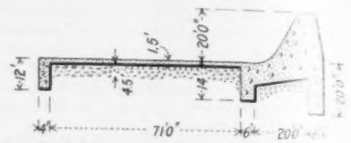
THE GRANITE REEF DIVERSION DAM OF THE SALT RIVER PROJECT, OF THE U. S. RECLAMATION SERVICE, ARIZONA.

By JAY D. STANNARD.*

The accompanying illustration shows a cross-section of the Granite Reef diversion dam, Salt River Project, Arizona, where the bed rock was of such a depth as to make it impracticable to extend the foundations to it.†

Three curtain walls were built extending across the stream in this section. The one under the upper toe of the dam is 6 ft. in width and is carried down to a depth of about 18 ft. below the elevation of the apron below the dam. The curtain wall under the lower toe of the dam is carried to a depth of 14 ft. below the surface of the apron. Through this wall were left openings 6 ins. square, placed 5 ft. apart and [illegible] ft. above the bottom of the wall. These openings permit the water that would collect under the dam to drain out under the apron. The apron of concrete is made on a foundation of [illegible] boulders, having a thickness of 4½ ft. The thickness of the apron is 1½ ft. It is laid in squares of about 10 ft. on a side. A space of about 3 ins. is left between the squares. This space permits the escape of water under the apron which is prevented from finding an outlet down the stream by the curtain wall 12 ft. deep that is built under the down-stream edge of the apron.

After the sluiceways were closed and water began to rise above the dam, the increased pressure caused the water to rise in the cracks that were left in the apron. This flow never amounted



Cross-Section of the Granite Reef Diversion Dam, Salt River Project, Arizona.

to more than 2 or 3 cu. ft. per sec., and so far as observations can now be made under flood conditions, has entirely stopped.

The bed of the river in this section is composed of gravel and boulders that extend to a depth of at least 70 ft., the depth penetrated by the diamond drill. Water pressure, due to raising the surface of the water above the dam, will be readily transmitted throughout this porous material, and the construction of the curtain walls and apron will permit the water to pass through and reduce the pressure at these points.

At the present writing (September, 1908) the bed of the stream above the dam has been silted up to within 9 ft. of the crest of the dam, and it is thought this deposit will completely cut off all further seepage under the dam.

*Engineer, U. S. Reclamation Service.

†Many of our readers will remember that the Salt River Project includes the Roosevelt Dam; see Eng. News, Sept. 10, 1908, for article entitled "Progress on the Roosevelt Dam."—Ed.

THE FIRST AIRSHIP GARAGE.—In preparation for the time when flying will become as popular as motoring, the management of Briarcliff Lodge, at Briarcliff Manor, N. Y., 30 miles from New York City, is having plans prepared for the erection for an immense airship receiving and dispatching platform on the roof of the hotel. The cost will be nearly $100,000.

Details are being worked out by Guy King, a Philadelphia architect, who designed Briarcliff Lodge. . . . The flying machine platform will cover the entire roof, and will extend several feet beyond. Elevators will enable guests to go direct from their flying machines to the lower part of the hotel.

Extending the entire 350-ft. length of the building, and several feet beyond on trestle work will be a "starting track" with the proper slope. To one side will be enormous barns, in which airships may be housed.

One of the most difficult problems was how to provide for receiving flying machines by night. This was finally solved by a special arrangement of shaded lights, which cannot confuse the operators. Another strong beam of light will be thrown directly upward to guide distant aviators to the place.—"Philadelphia North American." Sept. 25, 1908.

THE DAMASCUS & MECCA RAILWAY, which is under construction by the Turkish government, has been completed to Medina, and its extension to Mecca is said to be assured. These are the two "holy cities" of the Mohammedans, and have been visited by very few Christians, owing to the jealousy and opposition of the former, who regard all such visits as profanation. From Damascus the railway runs south to Akaba, and thence parallel with the Red Sea (but 100 miles from it) to Medina, about 800 miles. The extension will turn to the Red Sea port of Rabig, and thence inland again to Mecca, about 200 miles. It is a narrow-gage line (3½ ft.) built by Turkish troops and paid for by religious contributions from the people and the Sultan. Damascus has two railways to the Mediterranean ports of Haifa and Beirut, while another line extends northward to Aleppo. The projected railway from Eregli (the terminal of railways from Constantinople and Smyrna) to Mosul, Bagdad and the Persian Gulf will have a branch to Aleppo. This connection would complete a most important military communication by rail from Constantinople through Asiatic Turkey. The Mecca railway is said to have been built partly for the convenience of the vast crowds of pilgrims who visit the "holy cities," and partly for military purposes.

ENGINEERING NEWS

A Journal of Civil, Mechanical, Mining and Electrical Engineering

Published every Thursday by

THE ENGINEERING NEWS PUBLISHING CO.

220 BROADWAY, NEW YORK

BRANCH OFFICES

CHICAGO: 1636 Monadnock Block
WASHINGTON, D. C.: Home Life Building
ATLANTA: Candler Building
RUDOLPH MOSSE, BERLIN AND HAMBURG, GERMANY
Z. P. MARUYA & CO., Ltd., TOKYO, JAPAN

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Entered at the New York Post-Office as Second-Class Matter.

A prominent engineer remarked in a private conversation recently that the missionary work for water meters had been accomplished and that henceforth the task is to install these water-saving and cost-proportioning devices. We agree with this statement, in the main, but of course there are exceptions to it, and doubtless will be for some years to come. Only a few days ago the local press of Pittsburg, Pa., told of a trip made by city officials to Cleveland, O., to learn at first hand how meters work there and whether disease germs really lurk in their dark labyrinthine recesses, ready to rush out at any minute seeking whom they may devour. Doubtless the germ feature of the story was overdrawn, but the slowness of Pittsburg to fall into line and do something really effective to cut down its enormous water waste indicates that there are still darkest Africas for meter missionaries to invade and enlighten.

Save for the agitation over joining with the other national engineering societies in the Engineering Building few if any other questions of such vital interest and importance as the proposed constitutional amendments on the method of electing new members have ever come before the American Society of Civil Engineers. The last day for voting on this proposed amendment will be Oct. 7. Most of the strongest arguments pro and con that have come to our attention may be found in letters and extracts from letters published on a succeeding page or in letters which appeared in our issues of Sept. 10 and 17. We refrain from taking sides in this discussion, further than to say most emphatically that the present method of choosing new members has resulted in several instances of rank injustice, according to our conception of a high-grade engineering society. Whether such injustice, or at least much injustice, is or is not inevitable under any plan, and if so whether lodging the choice entirely with the Board of Direction or leaving it where it is, but increasing the number of negative votes necessary for defeating a candidate would be the better way, are questions which for the present we shall leave to the members of the society.

The forest fires in Maine, New York, Michigan, Wisconsin, Minnesota, California and Canada during the past two months have consumed or seriously damaged a considerable percentage of the remaining and prospective merchantable timber supply of the continent. Coming as these fires have at a time when public attention was being forcibly drawn to our rapidly waning timber supply they raise the question, can nothing be done to prevent the recurrence of such disasters in future years? The best answer to the question perhaps is that on the various U. S. Forest Reservations a vigilant force of able rangers has eliminated fires and that similar measures would doubtless effect the same desirable end elsewhere. The difficulty outside the U. S. Reservations lies chiefly in the fact that most of the forested areas are in private ownership and that there is no well-organized public means of either preventing the setting of fires or of stopping their spread when once set. Obviously, the national government can do little or nothing, except educational work, outside the public lands. Few of the state governments have made any serious attempt to prevent forest fires, and the private owners of forested areas, on whom timber fire losses primarily fall, have not as yet been far-sighted enough to see and act on the necessity for systematic fire-prevention work.

We have spoken of these timber fire losses as falling "primarily" on the private owners of forested areas. The heaviest sufferers, in the long run, are that vast congerie of people conveniently called the "general public." The individual members of that ubiquitous body are already paying twice the prices of a few years back for their various timber supplies. Every large burned area accelerates the inevitable increase in the price of all classes of forest products, and the public must pay the bill. It therefore behooves the public to awake to the situation and to establish as speedily as possible a public system of forest-fire inspection and prevention. "Minute men" are as urgently needed for this work as they were when the liberties of the people seemed threatened a century or more ago, and the fire wardens of each town or larger district need to be as vigilant in their way to-day as were the guardians of liberty of old. Something to this end has been done for the forests of a few states, but for the most part it is altogether too inadequate as to men, money and intelligence, to say nothing of whatever grounds there may be for recent assertions that the fire fighters in the Adirondacks have been laggards at their work and in some cases have even set fires, all to increase their pay warrants on local or state treasuries. We doubt whether such charges of out-and-out mendacity are often warranted, but concerning dilatoriness and ill-organized and ineffective work through lack of proper system and direction there is, unfortunately, no reason to question. With the present widespread awakening to the necessity for the conservation of natural resources there is hope for constantly increasing protection of the forests from both the hands of man and the ravages of the elements. May the day of adequate protection be not far distant!

The observations on English roads and the cause of their superiority over American roads, printed in editorial correspondence in our last issue, compel attention to a sore point of American road administration that is closely related to the question of road excellence. Our observer abroad spoke of

> the contrast between the macadamized roads as one sees them here in England and the macadamized roads in the United States,

even if only the best American roads be considered—"the best that we can show in New Jersey or New York, or Massachusetts." It is to be remembered that this refers not to the new, unused road, but to the road in its average condition, when actively carrying traffic. The newly built macadam road, as we know it, is excellent, and calls for no criticism. The objections lie against the effects of traffic and maintenance. Our editorial correspondence spoke of the influence of the former; a word on the effect of maintenance deserves to be coupled with it.

Professor I. O. Baker, in the course of a recent discussion before the American Society of Civil Engineers,* uses some pointed phrases. He speaks of "the ordinarily inefficient system of caring for roads." This refers to our own country only. In England, says our foreign letter,

> these English roads can be and are swept. . . . On our American macadam roads, street cleaning, or at least street sweeping, is practically unknown.

It is safe to go a step farther, and say that road repair, or at least proper road repair, is practically unknown. "Repair" here does not mean the restoration of ruined portions of the road, but current maintenance. England not only has regular road repair, but even the refinement of sweeping. Professor Baker says:

> Most ostensible road work is a positive damage

because of worthless side ditches, and, he might have added, because of several additional causes. He says this of earth roads, it is true, but it is just as true of macadam roads. In fact it is more strongly true of macadamized roads, because the earth road more quickly gets into an intolerable condition, and therefore is more speedily attended to.

We spoke of earth roads in the early part of the present year, urging that the year's maintenance and repair work be done at the proper season, and in less inefficient manner that is customary. The improvement of earth roads is entirely a matter of maintenance, and here the activities of such road-students as Professor Baker, and of the engineers and road authorities of the Valley states, are bringing about steadily better conditions. At least they are forcing the universal recognition of the fact that to have earth roads at all they must be worked regularly and effectively. Our next need is to secure an equal recognition of the fact that the macadamized roads are equally in need of regular—and above all intelligent—maintenance.

The macadam roads that are most often pointed to with pride, "the best that we can show in New Jersey or New York, or Massachusetts," receive no greater maintenance attention than our worst-neglected roads. They are built well, but they are not maintained well; with the partial exception, perhaps, of the roads of one state, they are not maintained at all, in fact. And this, no doubt, is responsible for some of the difference between American and English roads. To quote again from Professor Baker:

> The system of employing a man to give his entire time to the road is almost a *necessity* with first-class broken-stone roads, the maintenance of which requires intimate knowledge and constant attention.

But where in our country do the macadam roads enjoy the benefit of this system? And where do they get the benefit of the "intimate knowledge" that is essential?

Not that there is no money spent on road maintenance. Such money is spent, although far too little, if we may judge from the remarks on this subject made in the last report of the road authorities of one of the states quoted. The trouble is that the money spent is practically all wasted. The work is under no competent direction. Political officials without the slightest knowledge of road construction are in full control, and the actual work is done by equally incompetent hands.

No one appears to realize that costly and carefully-designed stone roads are worth a proportionate amount and kind of attention to maintain them, and that patronage is an inefficient device for the purpose.

Proper results cannot be expected under such a system, or lack of system. Until the maintenance of the macadam road network is put under able and conscientious direction the present conditions will continue. What form of organization is to be selected for this direction we are not prepared to say, and indeed the subject is difficult; but it is needless to attempt to deal with it now, or before there is a general realization of the need for a changed system. The community must come to recognize that it cannot afford to consign its investment of $5,000 to $8,000 per mile to rot and neglect.

*See "Proceedings," Sept. 1908, pp. 998-1016.

LOOSE SPECIFICATIONS AND DISHONEST CONTRACTS.

A recent call for bids on a piece of public work was framed in such terms that the work to be done by the contractor could not be estimated within a cost range of even one to ten. Earth was to be moved, an approximate amount being specified; but from where to where was left entirely undefined except by the words "as may be ordered." There was no map or plan. The depths and distribution of cut and fill, whether the excavations would average 6 ins. or 6 ft., and whether the average haul would be 60 ft. or 1,600, were not stated, being covered by the same presumptuous phrase. Auxiliary work, such as removing structures, pavement and sod ("as may be ordered") was undefined in both amount and character, and was referred to only by such vague terms that almost anything could have been demanded under this head; and the capital part of the matter was that this miscellaneous work was required to be included in the price bid for moving earth, per cubic yard. By no possibility could anyone make an intelligent bid on the work unless he had private knowledge of what the engineer, or his department head, would be likely to ask for under the contract. The whole call for bids was clearly a device for keeping away outsiders and ensuring that the job would go to a favored contractor. Under these circumstances, it is a point of but secondary interest that there is grave doubt whether the work was really needed at all.

This case is about the most flagrant example of a "fixed" letting that has ever come to our notice. Fortunately it aborted, as some vigorous protesting led to a fear of unpleasant publicity; the bids were rejected and the renewal of the call was accompanied by more tolerable specifications. But the failure of the plot makes it no less shameful than if it had succeeded.

Now we may easily find comfort in the fact that this was no work of the engineer. It is true that an engineer may have lent himself to the crooked purpose by passing out over his name the "specifications" accompanying the call for bids, or perhaps even by drawing up the meaningless description. That is possible, for in some localities there are, unfortunately, a few engineering officials who are bound hand and foot by their political taskmasters and lack the backbone to refuse their assistance in graft enterprises of this sort—call it "honest graft," if they will, for consolation. But the actual dishonesty lies upon the department head, who directs with absolute power and who is not required either in law or in custom to take the advice or suggestion of his engineering subordinates. Moreover, in the case cited we believe no engineering official was concerned at any stage, at least by name. Thus we may, if our conscience be light, absolve the engineering profession from any blame.

Suppose we look at the matter more searchingly, however. We know that by far the most specifications for construction contracts are drawn by engineers, and that the customs and practices which they have established in this work constitute a potent, authoritative precedent for *all* specifications. Let us ask whether engineers have been conscientiously free from those things which in unscrupulous hands are turned to evil account. Only if this finds an affirmative answer can we clear ourselves fully from taint.

In the present case, for example, the mischief lay in looseness of statement of what was required—looseness carried to the extreme of utter absurdity, it is true, but still only the legitimate descendant of what we ordinarily describe as looseness of specification. Is such looseness unknown in contracts? Are engineers' specifications quite pure and clean in this respect? Or do we not, in fact, find rather frequent instances of that very fault in specifications for work of even the fairest character? Engineering News has repeatedly made a plea for the rigid elimination of uncertainty, obscurity and arbitrariness from specifications. And some two or three years ago we took special pleasure in recording an important court decision which condemned a troublesome (though doubtless entirely honest) alternative requirement in the call for bids on a large public bridge. This particular case was exceptional, it is true, but only because of the details of the point at law. Questions left for subsequent determination are by no means rare in contracts. Indeed, complete definition, in the contract, of the entire work to be done, is the exception rather than the rule.

But it is not everywhere admitted that loose or general specifying is to be condemned. We have heard earnest justifications for it, and anyone will be able to recall similar arguments, if indeed he does not himself support them. Such arguments are grounded variously on the necessity for leeway in supervising the execution of the work, the leeway being necessary for the good of all parties; on the need of haste in urgent work, which does not permit of thorough preliminary examination and complete design in advance of contracting; on the desirability of selecting one particular contractor, with whom the engineer is familiar and who can be relied upon for efficient execution, and on a multitude of similar grounds. Some few persons go much farther than this, and say that so long as the contract-letting authority knows what is a proper price for the work, and is sufficiently powerful to compel full performance in spite of the insufficiency of the specification, it makes no difference at all whether the specifications are precise and complete or the opposite, so that the extra time and labor required to make them complete are simply wasted.

This latter argument, we need hardly say, is at all times indefensible, however plausible it may appear in one or another individual case. It is equivalent to the assertion that any public official (or some specific official), by virtue of the confidence reposed in him by his election or appointment, or because of his known probity, or perhaps because of his large personal interests which make it ridiculous to suppose that he could be other than strictly honest in a trivial matter, is above the law and principle to which ordinary men must conform, and can disregard that accountability for trust which we impose upon other men. Assertions of this character are too familiar to us from public life to receive much credence; they are the stock defences for every arbitrary, unfair or oppressive act on the part of those who exercise delegated authority. Neither principle nor practice can justify them.

The other arguments, however, are no less fallacious, we maintain. Each is a concession in some degree to the extremist argument just discussed, and for that very reason it must fail. Over and above this, however, it must fail because it is the inevitable predecessor and parent of such pieces of mocking fraud as the one cited at the opening. No one lives who is discerning enough, and strong enough, to mark out a line between the permissible and the damnable in looseness of specification.

All this applies primarily to public work contracts. There are some fundamental differences between specifying for private and for public work, and they are widely enough appreciated. Acts or omissions which may be praiseworthy in private work become criminal in public work, as for example it may be the best possible thing for a private concern to let a contract without competition, to a selected contractor, whereas this same thing becomes criminal when applied by a public official to public work. But on the other hand there are very many principles which hold with equal force for private as for public work contracts, and whose violation is just as improper in the one as in the other. On a future occasion we hope to discuss this matter, with the object of determining the real differences and the points of agreement between the two classes of work. The subject of loose or open specifying, it is certain, will be found among those features which are to be shunned equally in both. In every contract, and in every call for bids, whether for individual, private corporation or community, the description of the work to be done must be exact and complete, to the end that there may be a fair, just and unmistakable basis for action between man and man. Every violation of this principle is an offense against the ethics of engineering practice.

LETTERS TO THE EDITOR.

Pontoon Drawbridges.

Sir: In the article on "Pontoon or Floating Drawbridges" in your issue of April 30, there is the following statement (on p. 476):

> The pontoon is 396 ft. long and 41 ft. wide. It is 6 ft. 6 ins. deep for 316 ft., but for 20 ft. at each end the depth is 7 ft. 6 ins., the change being made in a distance of 20 ft. The purpose of this is to give greater buoyancy to check the increased submersion as the weight of the train comes upon the end.

This statement would seem to be in error, as the increased submersion due to the weight of the train would depend only upon the shape and area of a horizontal section of the pontoon at the water line.

Does not this increased depth at the ends add slightly to the complexity of the design and the expense of the bridge without any beneficial results?

Lamar, Colo. E. A. Connell.

[This feature of increased depth at the ends of the pontoon was embodied only in the first pontoons of the Chicago, Milwaukee & St. Paul Ry. bridge at Reeds Landing, and was not used in the pontoons used by the railway at other places. We are informed that it was not incorporated in those of later construction for the reason that no benefit could be ascribed to it which would compensate for the slight increase in the complexity of the design. It may be noted, however, that it was embodied also in the pontoon of the highway drawbridge at Lacon, Ill.—Ed.]

The Proposed Membership Amendments to the Constitution of the American Society of Civil Engineers.

Sir: The writer has been much interested in the letters of Mr. Whinery and Mr. Herschel, with reference to this subject, which is a very live topic; and since your columns have been opened for its discussion is glad to express his views with reference to the matter.

During the past eight years as an associate member the writer has never had occasion to vote a negative ballot for membership, but is somewhat jealous of his rights under the constitution, and would not hesitate to do so if he thought it the proper course, and that without explaining his reasons to the Board of Direction upon receipt of the Blue List.

If one will examine the list of members constituting the Board of Direction, he will naturally find there the names of the chiefs and the department heads of the larger engineering works about the country and near New York, as well as the different public works departments of the city. It naturally would be poor policy for any one employed on these works, under these conditions, to explain to the Board of Direction his objections to a candidate, especially if employed on the same work. He might do personal injury both to the candidate and himself. It should be borne in mind that the Board of Direction, except in rare cases, knows little about the candidate except what he himself states in his application for membership, or from his endorsers, who are usually his friends; while his associates and those with whom he comes in contact may know much more, some of which may not be in his favor.

This lack of definite knowledge on the part of the Board results in two things:

(1) An improper classification of the candidate on the ballot slip. There have been at least some elected to the grade of member, whose "ability to design" consisted in being able to sign their name at the bottom of a plan. (2) It results in rejections by the membership, not from a desire to exclude the candidate from the society, but because he is not deemed qualified for the grade in which he is passed to ballot, and there is no other course open to the membership. The writer knows this to be true in at least one case, and from conversation with other members he believes it true in many cases. It is believed that a far more equitable method of election would be for the members to pass, by ballot, not only upon the question of acceptance or rejection, but upon the grade to which the candidate should be elected.

The writer does not know who the particular candidate was, whose rejection caused this amendment to be presented, but is of the belief that if twenty corporate members conscientiously voted against him, he was justly excluded, at least from the grade in which he was passed to ballot; and if the negative ballots were not cast from conscientious scruples that fact is itself evidence that there are already members in the society without whom the general standing of the membership would be higher.

The writer is not in favor of removing the restrictions as to membership. Yours very truly,

E. G. Haines, Assoc. M. Am. Soc. C. E.

254 Jefferson Ave., Richmond Hill, N. Y., Sept. 19, 1908.

Sir: I judge from a letter which I received to-day that a letter campaign has been inaugurated in favor of the amendment to the Constitution of the American So-

ciety of Civil Engineers, which provides for the election of members through the Board of Direction. I have received a request to give my opinion regarding this matter and have done so in the following letter:

Sir: I have your letter of Sept. 18 regarding the proposed amendment to the Constitution of the American Society of Civil Engineers, which provides for the election of members through the Board of Direction. I am most emphatically opposed to this amendment. I firmly believe that it is safer for the society to leave the election of new members in the hands of the members themselves than to delegate this authority to the Board of Direction. I mean by this to cast no reflection upon the Board. I have been a member of the Board and appreciate the earnest and faithful work it does for the society; but I am strongly of the opinion that this matter should be left in the hands of the corporate members. I believe that with almost no exception if an engineer has so conducted himself that 20 members of our society can be found to vote against him he should not be elected a member of the society. It would be difficult to convince me that a spiteful person could obtain the consent of as many as 20 members of our society to vote against an applicant unless almost all of those members knew that the applicant was not fit to be a member of the society.

I not only am not in favor of this amendment, but I am not in favor of increasing the number of negative votes beyond the 20 now fixed by the Constitution. There may be as many as 20 sneaks and back-biters in our organization, but I do not believe that any one or two men know all of them or that any one or two men could collect a sufficient number of such sneaks as to prevent an applicant, fit to be a member, from being elected.

Because it is a little easier or a little cheaper to put this matter in the hands of the Board of Direction is no reason why the amendment should be adopted. This question of admission to membership in the society is by far the most important question which the corporate members have to consider. I believe that one reason why the American Society of Civil Engineers has attained its present preeminent position among the similar organizations of this country is because careful scrutiny is made by the membership in general of applicants for membership and care has been taken to prevent, as far as possible, dishonest persons from being elected to membership.

The more safeguards we can throw around the corporate membership to make it maintain its present high character the better. I believe this matter of membership to be better safeguarded in the hands of the corporate members.

If you care to publish this letter I shall be glad to have you do so.

Yours truly,

Palmer C. Ricketts,

President Rensselaer Polytechnic Institute.

Troy, N. Y., Sept. 23, 1908.

Sir: I have sent out the following letter to the members of the American Society of Civil Engineers, relative to the proposed amendment of the Constitution, pertaining to the election of members:

I trust that you may see your way clear to vote for the proposed amendment to the Constitution of the American Society of Civil Engineers, which provides for the election of members through the Board of Direction.

The society is so large, and the members so scattered, that the plan to trust with the Board of Direction the election of new members seems reasonable. The larger we become the more difficult it is to vote intelligently and the easier it is for individuals through personal reasons, or otherwise, to secure the necessary percentage of negative votes to defeat a candidate.

The society, as you know, is not a secret association or a club, but a professional society, and every one who is able to qualify through personal character and professional attainments should have the right to become a member.

My sole object in writing you is because of my interest in the welfare of the society, of which I have been a member for more than twenty years, and I shall be gratified if at any time you care to send me your views on matters pertaining to the society.

Accompanying the above letter was sent the following letter by Mr. John F. Wallace:

As Vice-President, President and Past President, I have served eight years as a member of the Board of Direction of the American Society of Civil Engineers and as a result of that experience believe that the proposed amendment to the Constitution providing for the election of members through the Board of Direction is for the best interests of the society and at the same time provides all the necessary safeguards against the admission of improper persons.

An engineer rarely acquires prominence without incurring at some time the enmity of existing members of the society and for this reason eminent engineers frequently hesitate to apply for admission as the efforts of members personally opposed to them may result in blackballing. An applicant whose record is colorless is often less liable to attack than one of the highest professional standing who would be an honor to the society. Action by the Board of Direction should insure an impartial investigation of the standing of all candidates and produce results more in harmony with the spirit and dignity of the society.

I hope you will pardon me for bringing the matter to your attention but my only motive is the welfare of our organization.

To my letter many replies have been received, a very large proportion of which are favorable to the amendment. Extracts from some of these letters follow:

In two instances I have been requested to cast a black ball. In one case by the member who had nominated the candidate, and looking into the matter I found that it was a case where for business reasons the nomination had been made, but for personal reasons it was desired that the candidate should not be elected. All this only goes to show to what use the society is being put.

(Signed) Chas. H. Moore.

Election by the Board brings out more complete information, the reasons for which are: (a) members, especially those opposed to a nominee, know it is their only chance and (b) the timid men seem to have more confidence that information given on which only the Board will vote will not leak out. Hence, under the same rules and requirements you get a higher average to the good.

(Signed) John Thompson.

My views have changed somewhat and I am now inclined to believe that it would be better to put the election in the hands of the Directors. It would intensify their sense of responsibility and would make them more careful and thorough in collecting information. Doubtless it would sometimes result in holding up a candidate for several months during the slow process of getting in definite information, but that would not be a real injury to the candidate. It is certainly true that election by the society at large weakens the sense of responsibility on all hands and it appears to me now that it would be better to try the proposed plan of election by the Directors.

(Signed) H. G. Prout.

I feel very strongly that the adoption of this amendment is vital to the interests of the society. I do not see that any advantage is secured by the present method of electing members. It gives opportunities for injustice and even inhumanity, because rejection of an applicant might affect his business. The Board of Directors is not only representative but it is the only means the society has for exercising deliberative action in cases of such personal nature as election to membership.

(Signed) Geo. H. Pegram.

I quite coincide with your views and have already voted in favor of the change. Long experience in the American Society, and also in the Canadian Society of Civil Engineers, as a member and as serving on the boards, in both of which bodies the election to membership has hitherto been by the ballots of the entire membership, and experience in the Institution of Civil Engineers (England), in which the election is by the Council, has entirely convinced me that the election by the Board of Directors would be altogether better for the American Society.

(Signed) John Kennedy.

Hoping that you will be able to find space for this communication in your next issue, I am,

Yours truly,

Wm. L. Saunders,

President, Ingersoll-Rand Drill Co.

11 Broadway, New York City, Sept. 28, 1908.

[Other letters on this subject, from Mr. Samuel Whinery and Mr. Clemens Herschel, were published in our issues of Sept. 10 and 17, respectively. Both were against the amendment.

We have received a printed circular letter, evidently sent to the whole membership, purporting to have been signed by 22 members. This circular is against the amendment, but inasmuch as it was not vouched for by any letter of transmission, we will not quote the signatures. The letter makes an argument which is not contained in the other correspondence which we have received, as follows:

The Board of Direction comprises 30 members. Under the proposed amendment a total vote of 25 will be required for election, while three adverse votes will reject an applicant. District No. 1, from which at least nine members of the Board of Direction are chosen, comprises about 900 corporate members and includes a territory within a radius of fifty miles of the New York post-office. There are about 2,800 corporate members in the remaining six districts. The constitution provides that there shall be but two directors from any district, except District No. 1. In addition to the six directors and three officers required to be elected from District No. 1, the other officials and Past-Presidents, who are members of the Board of Direction, may be residents of District No. 1. It follows, therefore, that District No. 1, representing only one-quarter of the corporate membership, usually has from 10 to 15 members of the Board of Direction, and may and probably often does have a majority of the vote in that board. The effect of passing the proposed amendment will be to place the election of members largely in the control of District No. 1, leaving the up-state members and all other districts, representing by far the larger aggregate membership, with but little to say regarding the election of members, even from their own districts, and taking away from the membership the power which it now possesses of voting adversely on undesirable applications. If the amendment is adopted, the Board of Direction, as a whole, cannot possibly acquire the same degree of intimate knowledge of the qualifications of applicants from districts, other than No. 1, that is possessed by members in the district in which the applicant resides and to whom he is personally known, nor would the members in the district have any practical control of the votes of the directors representing them.

The ballots on this amendment close Oct. 7. Brief comment on the proposed amendment will be found in our editorial columns.—Ed.]

The Fitchburg Cooperative High School Industrial Course.

Sir: It seems to me that you have taken the wrong point of view in regard to the proposed high school industrial course at Fitchburg, Mass. The purpose of this course, as I understand it, is not to take young men who would normally finish the usual four years of high school, and put them into a cooperative shop course. This seems to be your assumption.

On the contrary, the plan intends to give a chance to the young man who would have to leave school for good and all at the age of fourteen to go into industrial life. As you undoubtedly know, over 90% of the public school children leave the grade schools when the law permits them to do so, which, I think, in Massachusetts is at the age of fourteen. These little bread winners go into the various industries of their towns, and thereafter they have absolutely no chance for further instruction, except where a night school is in operation. It has been found by a very careful investigation that many of these children could go to school a little longer if some way were provided for them to earn a little money while they were doing so. This is where the cooperative system steps in. Do you think it is a wise policy to oppose a plan which will enable children to go to a high school, for, say, four years of half time work, when it seems to be the only means provided for them to get any schooling at all after they get into industrial life? You are taking a heavy burden of responsibility in opposing such a plan.

You will note that if a scheme of this sort were not put in operation, more than 90% of the children in the United States would not get, to use your own words, "fresh air, sunshine and pleasure during the years of adolescence." Nor would they have "memories of base-ball and foot-ball games, of fishing and hunting excursions, and all the rest that come from uninterrupted school and vacation days."

It is all very well to theorize on what ideal conditions should be, but the educator must take the conditions as he finds them; and these conditions are, as stated above, that a great majority of school children go into industrial life at the age of fourteen. It will not do to say that these conditions should not exist and dismiss the whole subject. We have got to take the conditions and do the best we can with them, and if we can add a total of two or three years of high school work to the education of these 90%, I think you must admit that we have gone a good distance toward solving the problem.

The course outlined is not intended to take the place of the regular high school course. It is simply enlarging the field of usefulness of the high school where it is most needed, and for the greatest number. It would be well for you to read the reports of the Massachusetts Industrial Education Commission on this subject of industrial workers.

Your reflections upon the course of studies outlined may, or may not, be good. I know it is a fact that the course published is merely tentative, just as the course we published here when we started our cooperative engineering courses was tentative. You will recall, if you will refer to my paper published in the Engineering News of July 9, 1908, that since we have started these courses, we have decided to put in six years of history work. We have made many more radical changes which the operation of the courses has brought about. The Fitchburg High School people will do the same thing.

Any constructive criticism to the Fitchburg course will certainly be welcome, but a sweeping condemnation of the whole system, it seems to me cannot stand in the face of the facts established through careful investigations.

The problem confronting the educator of to-day may be summed up as follows: About 95% of the children in our public schools are compelled to become bread winners at the age of about fourteen. They go into industrial life; they are confined to the shops practically every week of the year for eight to ten hours per day. What system can be arranged whereby the public schools can offer to these children and their employers a means of obtaining a higher degree of efficiency, and a better preparation for citizenship? If you can suggest a better means than the solution suggested at Fitchburg, you owe it to the public to give it. If you cannot, it seems to me unwise for you to knock the Fitchburg plan.

The rather sweeping slur on the American manufacturer implied in your editorial seems uncalled for. The American manufacturer of to-day is the "older New England mechanic," broad-minded and efficient; and the very fact that he enters into a plan whereby his employee leaves him every other week instead of being with him every week, to go to the public school for further training, seems in itself to answer your criticism.

Finally, the cooperative industrial course at Fitchburg is not intended to be a preparatory course for college. It must be evident, however, that for the exceptionally brilliant young man who ought to be trained as an engineer, it offers a means for meeting the entrance requirements of the best engineering colleges. What possible objection there can be to this is not evident to the writer.

Yours very truly,

Herman Schneider,

Dean, College of Engineering.

University of Cincinnati, Cincinnati, O., Sept. 22, 1908.

[In so far as the cooperative scheme bids fair to prolong the school life of boys who enter shops sooner or later we approve it and never intended to express any idea to the contrary. Our fear was and is that the Fitchburg plan will tempt boys and parents alike who are not compelled by scanty means to do so to sacrifice the broader studies for shop work. The 1900 U. S. Census figures showed that for the whole country 79% of all persons of from 10 to 14 years of age, inclusive, were in school. In Massachusetts the percentage was 91.2. For ages of 15 to 17 years, inclusive, the percentage in school was 41.8. The manufacturing states showed the highest percentages. The averages for the whole coun-

try were pulled down by such states and territories as Virginia, South Carolina, Oklahoma and Arizona. Moreover, only 24.3% of all persons in gainful occupations in 1900 were in manufacturing or mechanical pursuits.

We cannot see how the Fitchburg plan goes far in offering to even "exceptionally brilliant" young men "a means for meeting the entrance examinations of the best engineering colleges," although it would, of course, be an aid to that end. We intended no slur on the manufacturers, but merely called attention to the fact that a large majority of them, at least, as manufacturers, are naturally far more concerned with the economic than the cultural or broadly humanizing side of education.—Ed.]

THE COLLAPSE DURING RECONSTRUCTION OF A SPAN OF THE BALTIMORE & OHIO R. R. BRIDGE ACROSS THE SUSQUEHANNA.

Early on the morning of Sept. [illegible] the most northerly of the new spans under reconstruction on the bridge of the Baltimore & Ohio R. R. across the Susquehanna River collapsed under a train of coal gondolas. The entire framework of the structure, including a timber and steel falsework, the partially erected new truss, the old floor system carrying the track and a 300-ton traveler were precipitated into the river and onto the shore. Fortunately it was so early in the morning that no workmen were yet on the job and the trainmen were all on parts of the train which remained on the other spans of the bridge. The only person injured was a watchman, who happened to be on the span.

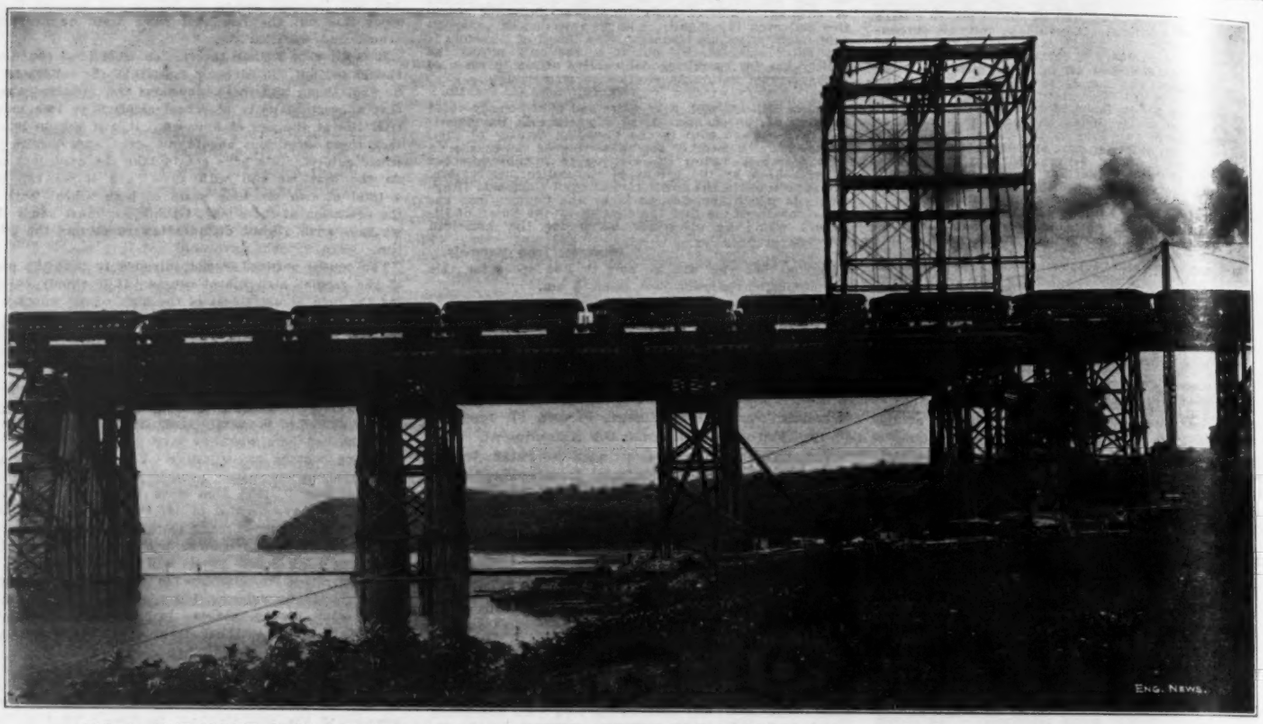

FIG. 1. THE 380-FT. SPAN OF THE B. & O. R. R. BRIDGE ACROSS THE SUSQUEHANNA RIVER WHICH COLLAPSED SEPT. 23. (View taken after removal of old truss and before erection of new truss. Looking west.)

The crossing of the B. & O. R. R. over the Susquehanna, about one mile above its mouth at Havre-de-Grace, Md., is one of the oldest bridges on the road. Some time before 1850 there was built there a single-track bridge of the old iron and timber Howe type which was replaced in 1884-85 by the iron structure now under reconstruction, a high-level single-track bridge, some 7,000 ft. long made up of a series of long through and deck trusses, two of which had 520-ft., four 480-ft. and three 380-ft. spans, and a 2,000-ft. viaduct across the island in the middle of the river. The new bridge, which is now being erected for the railway company by the American Bridge Co., is a double-track structure, much heavier than the original, but following it in size and general form of spans. Beginning at the north* shore of the river the present bridge comprises a short plate-girder, a riveted deck truss, and another plate-girder, all recently completed work; a 380-ft. through, double-track, pin-connected truss now under reconstruction—the span that collapsed—and beyond to the south other spans in various stages of reconstruction.

DESCRIPTION OF CONSTRUCTION.—As this crossing is on the main line of the railway between Washington and Philadelphia, it was

*The river at this point runs about southeast, but in this article that end of the bridge toward Philadelphia will be called north, the end toward Baltimore, south.

Notes and Queries.

In the article by Mr. W. H. Wilms in our issue of Sept. 17, the formula in the middle of the last column, p. 299, which reads

$$E = E' - O \csc \tfrac{1}{2} \Delta$$

should read

$$E = E' - O \sec \tfrac{1}{2} \Delta.$$

A correspondent sends us the following inquiry:

I am seeking information as to the practicability of electric welding in place for concrete reinforcing bars. If you can refer me to any publication giving up-to-date information in this line I will be much obliged. The structure under consideration will, if built, contain about 3,000,000 lbs. of steel. Alternating current could be cheaply furnished from a nearby plant.

We have no knowledge of any such application of electric welding in place in concrete reinforcement although there are unit frames on the market in which the rods are so joined. If any of our readers know of such a scheme, we would be very glad to hear about it.

Our article on the performance of the new steamers "Mauretania" and "Lusitania," in our issue of Sept. 10, p. 268, stated that 13.1 lbs. of coal per shaft-HP. was the average expenditure for the main engines. This is questioned by a reader, who believes that the figure 13.1 lbs. must apply to steam consumption. It is clear of course that the figure is in error somewhere, as 13.1 lbs. coal per HP.-hr. is inconsistent not only with decent engine-performance, but also with other figures given in the same article. On referring to the figures given earlier in the same paragraph (namely, 1,000 tons total per day, or 2,441,600 lbs., with 65,000 HP. average at the shaft, and 14.6% estimated to be consumed by the auxiliary services), we calculate from them a consumption of 1.34 lbs. coal per hour per shaft-HP. This makes it appear that the error is in a misplaced decimal-point, and that "13.1 lbs." should read "1.31 lbs."

The tubular bridge of the Grand Trunk Ry. at Montreal (the old Victoria Bridge) was mentioned in our issue of Sept. 17 in connection with some English bridges of the same time. It should be noted, however, that there were essential differences in the design. In the Menai Bridge (England) the top and bottom elements of the tubes were of cellular construction. In the Victoria Bridge (Canada) they were single layers of plate riveted to cross beams. The engineer for this latter bridge was Robert Stephenson. The heavy smoke in this long tube caused great discomfort to passengers. To avoid this, and also to reduce the corrosion due to smoke, an opening was cut in the plating along the middle of the roof of each span. An angle-iron was riveted along each side of the opening to compensate for the loss of strength due to the removal of the plating. The old Victoria Bridge (tubular) and the new Victoria Jubilee Bridge (truss) were described and illustrated in our issue of Aug. 26, 1897.

Three errors in the article "Wind Stresses in Reinforced-Concrete Chimneys," by Prof. E. R. Maurer, printed in our issue of Sept. 10, pp. 276-277, are to be corrected as follows:

Page 277, col. 1, the value of x_2, given as $\frac{\sin\theta}{\theta}$, should read $\frac{\sin\theta}{\pi - \theta}$.

The diagram Fig. 3 was calculated with the correct value of x_2.

Page 277, col. 3, for $\tan\frac{\theta}{2}$ read $\tan^2\frac{\theta}{2}$.

Page 276, col. 1, the value of I should be given as

$$I = n\,A_s\,\tfrac{1}{2}\,r^2 + A\,\tfrac{1}{4}\,(r_1^2 + r_2^2)$$
$$= \tfrac{1}{4}\,A\,(2n\,pr^2 + r_1^2 + r_2^2)$$

In accordance with this correction several obvious changes should be made in the calculations of Examples 1 and 2. The error does not affect Case 2.

BY-PRODUCT, PEAT-GAS PRODUCERS.—Capt. H. R. Sankey, R. E., M. Inst. C. E., in a recent paper before the British Association for the Advancement of Science, outlined a method that has been proposed for developing electric power from peat fuel in a plant containing gas engines, gas producers and apparatus for the recovery of by-products such as sulphate of ammonia, acetate of lime, methyl alcohol and heavy paraffine oils. The plant would be located on the Grand Canal, near Robertstown, Ireland. The peat used will be only partially dried and will be about 60% water. The proposed gas producers are similar to those using bituminous coals but of larger dimensions for the same output. The by-products are removed from the gas in the scrubbers.

necessary to carry on all the new work without disturbing the heavy traffic across the bridge, a procedure that required somewhat involved plans in the erection. The accompanying line cut and half-tone will show the method employed; the details in Fig. 2 are taken from sketches and therefore may not be absolutely correct as to dimensions, but the figure will serve to illustrate the general design.

Referring to Fig. 1, the two masonry piers there shown were the supports for the old 380-ft. through trusses and upon them the new span of equal length was being placed. In the opening two pile bents were driven, which, with the two framed works immediately adjoining each pier, supported three plate-girder spans, made up of girders, afterward to be used in other parts of the bridge. Upon these girders, four in transverse section, the existing floor system was blocked up and the work of removing the old trusses and erecting the new was carried on. Fig. 2 shows a half-section through the temporary spans, illustrating the method followed. The timbers shown were placed on the girders forming two runways, which each carried one of the trusses of the old, one of the trusses of the new bridge and at the outer edge, one track for the large traveler used in demolition and erection.

The work proceeded as follows: First, under each floor-beam of the old truss a crib-work was placed and blocked up so as to carry the load of the single track carrying the traffic across the bridge; then the old truss was taken down, leaving in place the old floor system of floor-beams, stringers and track. Then upon the runways between the old floor-beam blockings and the traveler tracks, blocking was placed upon which rested the posts of the new truss, the panels of which were of different length than the old so that the panel points came at different locations. The new pair of trusses once erected, it was intended to shift the track to the new floor system without disturbing the traffic.

The timber pile and frame towers, which had to carry the combined load of the temporary girders, the floor-system with the passing traffic, a 300-ton traveler and a 380-ft. double-track through bridge were made very heavy. The supporting bents, founded on timber piles figured at 10 tons per pile and driven to refusal at what the borings showed to be rock (or at least hardpan), were of 12 × 12-in. timbers thoroughly cross-braced in both directions, as the photographs show. The plate-girders, the largest a 114-ft. span, 9 ft. deep, were in rows of four, interbraced into two rows, and resting on regulation pyramidal shoes bolted to steel girders connecting the two bents of the timber tower. Above this the timber blocking rested, depending upon the weight of the superstructure for rigidity. The track floor system was the regulation built-up girder floor-beam and stringer except that some years ago, on account of supposed weakness in the usual riveted angle connections of the stringer to the floor-beam, stirrup hanger rods had been passed over the floor-beams and under the stringers, riveted to both members, to add to the strength of each connecting point.

It is reported that at no time since the start of the work on this span have there been any settlements. Daily inspection of the entire falsework was made, but there has been no necessity for shimming up, a condition according to a high official of the bridge company "never before noticed in any of our erecting experience in work of this size."

The traveler, which is shown in Figs. 1 and 5, was well guyed and braced in all directions, so that its swaying was hardly to be noticed even in a wind, which was not in evidence the morning of the collapse. In regard to the stability of the structure the bridge erectors further report that a few days before the accident in driving in the upper chord a pin which had stuck, at the same time that a heavy train was making excessive speed across the bridge, the vibration of the framework was quite marked, but that there was no evil result.

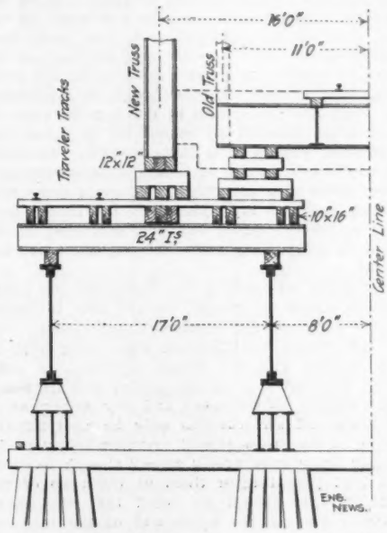

Fig. 2. Details of Falsework on Reconstruction of 380-ft. Span of B. & O. Bridge Across the Susquehanna.

THE COLLAPSE.—On July 13, 1908, the old trusses were removed and the falsework took the entire weight of the structure. From that time until Sept. 14, work was carried on at another part of the bridge, but on the latter date the erection of the new trusses was commenced. The view in Fig. 1 shows the span in the interim between the removal of the old and the erection of the new spans. On account of the very foggy weather prevailing during the middle of September it was impossible to take photographs of the work of erection so we can present no views showing the new trusses in place.

However, the view in Fig. 1 shows the condition of the work on the day of collapse except that at that time the new trusses had been erected for about 250 ft. in the middle of the span, leaving about 60 ft. incomplete on either end. The work was proceeding from the north toward the south (from right to left on Fig. 1) and the large combination timber and steel traveler, 104 ft. high and 72 ft. long in line of the bridge, was on the extreme south end of the span, in position to erect the last panel of the trusses at that end. As has been stated the accident occurred very early in the morning, so there were very few eye-witnesses, and the heavy fog increases the usual unreliability of the testimony of those who were on the ground. The best story of the accident, told by a blacksmith of a nearby quarry and corroborated in most of its details by the watchmen on the bridge, is as follows: About 6.30 a. m., of Sept. 23, a foggy and calm morning, the St. Louis express from New York passed safely over the bridge, going south. As soon as the way was clear a coal train came on the structure going north at the required speed of from four to seven miles per hour. When the locomotive and four cars had passed over the falsework of the 380-ft. span in question, the second car north of the south pier of that span, the car then being about under the north end of the traveler, was seen to go through the floor of the bridge; at the same time was heard a "puff," in the words of the observer, which might be construed to be the sound of escaping air from a broken air-pipe or valve. The car next behind then piled upon the car ahead and the large traveler wavered and finally toppled into the river, carrying with it the girders immediately under it. Then progressively toward the north, the other two girders and their timber supports were thrown down. Couplings on the cars at either pier parted, leaving six cars on the span south of the opening and two cars with the locomotives to the north.

THE CONDITION OF THE WRECKAGE.—Figs. 3 and 4 show the condition of the wreck looking west; Fig. 3 is taken from the shore alongside the framework attached to the north pier; Fig. 4 shows the wreckage between the two intermediate timber bents. The most southerly of the three plate-girder spans is over the channel of the river and the water is here so deep that little of the debris is visible, but that above water lies to the east of the line of bridge. A study of the wreckage shows that the framework against the south pier is not damaged except as it is scratched and cut by the falling steel and cars. The next span has fallen to the east and to the north, pushing with it the timber bent, in which the south row of piles is bent decidedly toward the north. The next, or middle girder span, fell straight down but in some manner carried the third and most northerly girder span to the north so that it crushed into the framework against the north masonry pier. This framework is shown in the right-hand side of Fig. 4.

The intricate nature of the twisted mass of debris, comprising as it does the new trusses, the old floor system and the timber and steel of the falsework, makes an examination or identification of the wreckage a difficult matter. The depth of water in the channel has prevented so far any exact knowledge of the position of the various parts of the structure under the south span, where the location of the fallen members

FIG. 3. VIEW OF WRECKAGE LOOKING TOWARD SOUTH PIER.

FIG. 4. WRECKAGE UNDER MIDDLE SPAN OF FALSEWORK.

may be a matter of importance in deciding upon a cause for the accident.

CAUSE OF THE COLLAPSE.—The accident is now being thoroughly investigated by both the bridge company and the railway and until a complete analysis of the strains on the timber is made and the position of the wreckage under water known, any explanation of the collapse cannot be assured. Leaving aside for the moment the question of the strength and stability of the bridge or its falsework, the prime factor governing the search for a cause is the testimony of the witnesses regarding the manner of the fall. If this evidence as to the succession of events was not distorted by the fog and the excitement of the moment the accident must have been the result of some local collapse immediately under the first car to go through the bridge. Fig. 2 shows a section through the floor system. If for any reason the car inside of the traveler had been thrown from the track with force enough to rip the stringer from the old floor-beam, in plunging through the opening thereby made it would have displaced the blocking under the last post erected of the new truss

Fig. 5. Traveler Used on B. & O. Bridge Across Susquehanna.
(Old 380-ft. truss in background.)

and thence hit the lower chord of the traveler on the outer track with force perhaps sufficient to unbalance that large framework, which in falling would have carried down the new truss and the falsework immediately under it. The collapse once started, the progressive movement along the falsework is easily understood.

This interpretation of the fall is upheld by the position of the wreckage visible under the southerly span. All of this, which is above water, lies well to the east of the line of bridge, while the wreckage of the northerly spans is directly under its original position. The probability of the explanation would be increased if it were certain that the falsework girders of the south span were on top of the framework of the traveler in the bottom of the channel, for under this view the traveler must have fallen first.

However, the testimony of eye-witnesses is notoriously inexact in details, and it is quite possible that the collapse started at the north end of the most southerly falsework girder span, which in slipping from the timber bent would have caused practically the same mental impression on the spectator as a car going through the floor. If such were the case, the failure might be explained by some fault in this first timber bent which would cause it to fall or, as has been suggested in some quarters, by the malicious dynamiting of the span by an explosive placed under this bent. As to the latter, the bridge company, which maintains open shop and has anticipated some trouble from the union men, has had lights and watchmen on the bridge to such an extent that it is highly improbable that opportunity could have been taken to place any dynamite. Some time ago several sticks of dynamite, which is not used on the work, were found near the bridge site and this had made the company extra cautious. The witnesses deny having heard anything like the report of an explosive, thus showing, if their testimony be exact, that the dynamite, if used, must have been placed under water, on the pile footings of the channel timber-bent, where it seems hardly probable that enough charges could be distributed to cause the destruction of the bent or even its movement to such an extent as to throw the falsework girders from their support. Evidence of explosives on the end of the falsework girders, when they are recovered, would show that the charges had been placed on the timber bent just under the girder supports and that in the noise of the passing train, the explosion was not heard.

As to the strength of the falsework, the information which at present we are able to secure is not sufficient for conclusive deductions. Until the official investigation, now being held by the railway and the bridge company, is complete, the drawings of the bridge and its falsework cannot be published and any statement as to loads and stresses can only be approximate. From all appearances and previous behavior the timber bents were amply strong enough to carry the load placed upon them at the time of the accident. It should be noted that the heavy traveler was at the south end of the span, so that the heaviest reaction from the traveler came at the south pier, which is now intact except for the scratching from the falling material. The load of the partially erected truss may be sufficient to bring the total reaction at the north pier of this short span up to the total reaction at the south pier.

The work of removing the debris is now going on and the trains of the Baltimore & Ohio R. R. are being carried across the Pennsylvania R. R. bridge about a mile down the river. A temporary track is being built from Aiken, the station on the B. & O. at the north bank of the river to Perryville, the similar station on the Pennsylvania, so that as little extra burden as possible shall be placed on the latter road. At present the Baltimore & Ohio trains take the Pennsylvania tracks at Wilmington and leave them at Swan's Creek, some three miles south of the river.

The Chief Engineer of the Baltimore & Ohio R. R., who is in final charge of the work, is Mr. D. D. Carothers, M. Am. Soc. C. E., and the railway interests are being looked after on the work by Mr. W. S. Bouton, Ass't Engineer of Bridges and Buildings. The details of reconstruction were all worked out by the American Bridge Co., under direction of Mr. H. F. Lofland, M. Am. Soc. C. E., General Manager of Erection.

THE WATER SERVICE AND INSURANCE RATES.*

By F. A. BARBOUR,† M. Am. Soc. C. E.

Some recent work involving the betterment of the existing water-works in several cities and towns and the fact that following these improvements reductions in the insurance rates were granted by the underwriters has suggested to the writer that a very brief description of the work done, in so far as it effected the fire service, and a statement of the reductions allowed might be of interest to this association.

In 1905 the development of a new supply for the city of St. John, N. B., was undertaken, the work involving the extension of the then existing pipe lines from a point about five miles distant from the city to a more distant source, at an elevation 138 ft. higher than the old supply. The pipe lines to the city included two 24-in. cast-iron, one laid in 1857 the other in 1873, and a 12-in. cast-iron, laid in 1851. The distribution system, which was generally of equal or greater age, some of the pipes having been laid as early as 1837, was fairly adequate in size requiring for efficient fire service additional pressure rather than enlargement of pipe diameters.

The extension of the works to the new supply included new supply mains and a concrete dam. The total expenditure, not including a pulp mill, purchased in order to avoid damages for diversion of water and which should yield an amount in rental equal to its cost, was about $300,000.

By the installation of these new works the pressure on the city was increased about 40 lbs., and from four to ten good direct fire streams—the number depending on the variation in surface levels—were made possible, while with engines from ten to twenty streams were obtained. With the old pipe lines not more than two direct streams were possible and the maximum draft with engines was probably not more than 2,000 gals. per min.

As a result of these improvements a reduction in the insurance rate of 25 cts. has been granted on mercantile property, the total yearly amount somewhat exceeding $30,000, or more than double the interest cost of the entire improvements.

A few notes on the work in St. John in connection with the old pipe lines may be of interest. The first 24-in. line, laid in 1857, has a thickness of about ⅜-in. The exterior surface shows no signs of having been coated; neither does it show any serious corrosion, the iron being good when broken to the extreme outer edge. About 1/16-in. of the interior surface is black and easily abraded. The joints were made of white pine and are in good condition, without leakage under the heavier pressure except in some places where the key-wedges were badly fitted. A section of this pipe, 3,000 ft. long, laid through marsh mud at tide level, was found to be badly disintegrated and was replaced. In many instances it was possible to cut the pipe with a knife through a considerable portion of its thickness. The new cast-iron pipe was embedded and wrapped with a layer of clay; such sections of the old pipe as had been laid in this material apparently having escaped any disintegrating effect of the tidal mud. Pipe laid in sand at about the same level was not affected, and of 21 lengths, each 9 ft. long and weighing 2,300 lbs. per sq. in., only one broke.

The pipe laid in 1873 was of two classes; one ⅞-in. thick and the other 1 in. thick. This pipe was coated and is in better condition than the pipe laid at the earlier dates. In this line four types of joints were employed, first a turned and bored joint, second a turned and bored joint made up with lead and a strap to hold the lead in place, third a wood-stave joint and fourth the ordinary lead joint.

The city of Fredericton, N. B., is supplied by pumping direct into the mains without elevated storage, the pumps necessarily running 24 hrs. In connection with the installation of a mechanical filtration plant recently constructed a clear water well 400,000 gals. capacity was provided largely as a fire reserve and the old pump of 1,500 gals. per min. capacity was reinforced by new apparatus of double this discharge. In time of fire a pressure of 80 lbs. is maintained at the station but the effective pressure at the hydrant is considerably less owing to an inadequate distribution system 24 years old and much incrusted by the action of the river water on the pipes.

As a result of the installation of the larger pump a reduction in the insurance rate has been made, equal, in yearly total, to about $6,000, or practically three times the interest on cost of the improvements chargeable to fire protection.

Improvements carried out between 1904 and 1905 included the construction of a reinforced concrete stand-pipe of 1,500,000 gals. capacity, with its top 100 ft. higher than that of the old stand-pipe, the laying of a second main between the pumping station and the point of storage and of a larger main from this latter point to the center of consumption. As a result of these improvements a 10% reduction of the mercantile rate of insurance was allowed by the underwriters.

The three preceding instances of reduction in the insurance rates as a result of improvements of the water service illustrate the value accorded to increased pressure in a gravity system, greater pumping capacity in a direct pressure system and larger storage and the duplication of mains in a pumping system with stand-pipe. The amount of the reductions was determined by committees representing underwriting associations—in two cases as a result of applications made by the municipal authorities after the work was completed and in the third case—that of St. John, N. B.—as a reward promised before the improvements were undertaken. It is safe to say that in none of these cases was there any attempt to estimate the value of the improvements in reducing the fire hazard on any definite basis derived by experience and made applicable by records of fire losses relative to the character of the water service. It would seem, however, that the time must soon arrive when such logical proportioning of rates to the factors controlling fire hazards will be possible.

As an illustration of schedule rating brief reference may be made to the Universal Mercantile Schedule developed in 1893, which, in some parts of the country, constitutes the principal basis of rating at the present time. By this schedule a key-rate was to be given

*Abstract of a paper read before the New England Water Works Association, Atlantic City, N. J., Sept. 24, 1908.

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each city and town, differing in each as was made necessary by local conditions. These key-rates were to be modified for individual risks in accordance with the variations in construction, occupancy and other particular hazards and as a basis for the establishment of the key-rates a standard building in a standard city, with gravity water-works, adequate distribution system, efficient fire department and other attributes, was conceived and for such a building in such an environment a basic rate was adopted from which the key-rates of other cities might be obtained by addition made for certain deficiencies. This schedule was by no means perfect and has been criticized in several particulars, but for the present purpose it serves to indicate the possibility of schedule rating and the advantage of definitely making known to each community its standing in the rating problem, its deficiencies and the penalties exacted and finally the improvements necessary to obtain the basic rate of the ideal city. Under such a method definite incentives to improved standards in the water service, fire department and building construction are presented by the resulting reduction in rates often made possible of attainment without increased cost to the community. And beyond all this, in broader outlook, there is the possibility that by such cooperation of municipal authorities and underwriting associations a long step forward would be taken toward the actual conservation of property values by lessening the fire losses which the payments of insurance never can make good and which, at the present time, in this country in amount per capita equal ten times the losses in Europe.

TESTS ON THE WATERPROOFING QUALITIES OF CLAY AND ALUM IN CONCRETE.

Following the lead set by the Board of Water Supply of New York City, as reported by Mr. Richard H. Gaines,* the Delaware & Ulster R. R. Co. has recently completed a series of tests to determine the waterproofing value of alum and colloidal clay as added ingredients to concrete. Through the courtesy of Mr. H. W. McGee, Engineer of Maintenance-of-Way of the railway, we are enabled here to reproduce the results of these experiments.

In all 174 test specimens are reported upon. These are divided in groups of three different kinds of clay, two different percentages of clay to cement mixture and three different percentages of alum solution, all compared with a cement and sand mortar with no clay but with the varying percentages of alum solution. The three clays used are described as follows: No. 1, "Red Bridge" clay, a hard, tough, dark red clay, very heavy and, when dry, hard to pulverize; No. 2, "Shandaken," a red clay, light in weight, rather easily pulverized when dry; No. 3, "Olive Branch," a gray clay, very heavy and easily pulverized. These clays were finely pulverized and screened to pass through a 2,500-mesh per sq. in. sieve and then thoroughly mixed with Portland cement by revolving the two in a cubical box. Two percentages of cement to clay were used, a 1:7, or 12½%, and a 2:7, or 22½%, mixture. The mixture was then used as the cement basis for the 1:3 cement sand mortar. This mortar was mixed with water having an alum solution of 0, 2½ and 5%, respectively, in the various test pieces.

Tension tests were made on briquettes of these various mixtures, ten each for the No. 1 clay, 12½% clay mixture and eight each for the remainder. These tension values are shown in Table I., as averages of the eight or ten briquettes for each combination.

TABLE I.—SHOWING TENSION TESTS ON CEMENT MORTAR MIXED WITH CLAY AND ALUM.
(lbs. per sq. in.)

Kind of clay.	% of alum.	Percentage of clay. 12½% 7 dys.	28 dys.	90 dys.	22% 7 dys.	28 dys.	90 dys.
No. 1.	0	200	332	417	189	222	331
	5	188	250	363	143	254	321
	2½	203	279	393	201	229	318
No. 2.	0	204	283	364	202	328	384
	5	208	258	328	139	217	294
	2½	194	321	349	193	310	365
No. 3.	0	234	332	417	219	321	361
	5	151	290	326	162	254	348
	2½	185	330	375	244	357	388
No clay.	0	222	388	392	...	...	...
	5	236	399	412	...	...	...
	2½	251	328	358	...	...	...

The permeability tests were carried out on the 12% clay mixture only, but on all the percentages of alum solution. The testing apparatus was as follows: For each test a piece of 3-in. wrought iron pipe about 1 ft. long and threaded at the lower end to connect with the city water pressure (about 110 lbs. per sq. in.) was arranged with a gage and regulator so that any desired pressure could be applied. The pieces of pipe were bent inward slightly at the iron-threaded end and filled from that end up with the mortar in thicknesses varying from three to eight inches. After setting 24 hrs. in air and 6 days under mortar the pressure was applied and the conditions of the exposed face of the concrete noted. These results are shown in the following table.

TABLE II.—EFFECT OF WATER PRESSURE ON CEMENT MORTAR WITH CLAY AND ALUM ADDITIONS.
(1:3 cement = 12½% clay: sand mixture.)

% Alum.	Thickness of test piece in inches.	Water pressure in lbs. per sq. in. 15	25	40
0	3	Moist	Sweating	Dripping
0	6	Dry	Dry	Moist
0	8	Dry	Dry	Dry
2½	3	Moist	Sweating	Dripping
5	3	Moist	Sweating	Dripping
5	6	Dry	Dry	Dry

Observation of this latter table will show that for thicknesses above 8 ins. a 12½% mixture of clay and cement should be impermeable and that for somewhat smaller thicknesses an alum solution adds to the water tightnesses. Table I. shows that a 12½% mixture of clay tends to increase the tensile strength of a mortar, but that a 22% clay addition and any percentage of alum solution will decrease the tensile strength. It must be noted that there are many gaps in the experiments and that they are somewhat limited in extent, so that the results are not conclusive, but they form an interesting basis for further study.

*Engineering News, Sept. 26, 1907, pp. 339, 344.

A COLLISION ON THE BERLIN ELEVATED Railway, Sept. 26, resulted in the death of 20 persons and the injury of 19 others. The collision occurred in the eastern commercial district at the crossing of three double tracks known as the "triangle." Two trains traveling in the same direction at high speed came together at the switch owing to a misunderstanding of signals. Two cars of one train were thrown from the track, and one of these fell to the street, 36 ft. below, turning over as it fell. Most of those killed and injured were in this car.

THE AIR BRAKES FAILED TO WORK on a Third Avenue elevated train in New York City, Sept. 28, causing it to run into the rear of a Bronx Park train which was stalled between Third and Fourth Sts. Two cars were derailed and 20 people injured.

A BURNING RAILWAY BRIDGE in Canada gave way under a freight train and six cars fell into the dry river bed below and were burned. Three men were killed. The accident occurred Sept. 27 on the Toronto, Hamilton & Buffalo Ry. at Mineral Springs, ten miles west of Hamilton, Ont. On account of the numerous bush fires in the vicinity, no attention was paid by the train crew to smoke seen near the bridge, and it was not until too late that its wooden supports were seen to be burning.

A HEAD-ON COLLISION on the Southwestern Traction Co.'s lines between Philadelphia and Chester, Pa., Sept. 23, wrecked both the cars and seriously injured 50 passengers. The accident is ascribed to the presence of a heavy fog.

A NUMBER OF RAILWAY ACCIDENTS have occurred during the past week. A Chicago, Burlington & Quincy passenger train running over the Northern Pacific Ry. collided head-on with a freight train at Young Point, Mont., Sept. 25. Twenty persons were killed and as many others injured. The two trains were scheduled to pass at Young Point, but the freight was delayed in reaching the siding, and the flagman sent out to stop the passenger train was unable to make himself seen in time to avert a collision on account of a heavy snowstorm. All the passengers killed were in the smoker, which was telescoped with the express car.

A passenger train bound for St. Louis on the St. Louis & San Francisco R. R. was completely derailed near Carthage, Mo., Sept. 24. Two persons were killed and 36 injured. The locomotive left the track while rounding a sharp curve at high speed and plunged down a 50-ft. embankment into Spring River, dragging with it the baggage car. The smoker and a day coach rolled over twice but did not go into the river.

The Chicago Limited on the Atchison, Topeka & Santa Fe Ry. was wrecked four miles east of St. John, Kan., Sept. 22. Only one person was seriously injured. One car, the diner, was overturned, while the locomotive and several other cars were derailed but remained upright. The accident is attributed to the weakening of the roadbed by recent rains.

A westbound fast mail train on the New York Central Ry. ran into the rear of a West Shore passenger train that had been held in one of the blocks a short distance west of Little Falls, N. Y., Sept. 24. Four postal clerks were injured. The collision is ascribed to a heavy fog which obliterated the signals.

A HURRICANE IN THE BAHAMAS, Sept. 11-14, destroyed an immense amount of property on ten of the islands, and wrecked a number of ships. Only fragmentary reports have as yet been received, mainly from Long Island, where all the settlements are said to have been practically obliterated. The principal town, Clarence, has only five houses left standing.

AN ACCIDENTAL EXPLOSION of dynamite near Tobyhanna, Pa., Sept. 27, killed five men. The accident occurred at the Cross Keys Cut on the Delaware, Lackawanna & Western R. R. while a hole containing 18 ins. of dynamite was being tamped. It is said that the bodies of the victims were assembled by matching their clothing.

A 7.6-IN GUN EXPLODED on the French armored cruiser "Latouche Tréville" at Toulon, France, Sept. 22, killing the entire gun crew of 13 men and completely wrecking the after turret.

A TRADING VESSEL WAS WRECKED on Coronation Island, near Sitka, Alaska, Sept. 22, and it is reported that 110 of her crew were drowned. She was a steel bark, known as the "Star of Bengal," and belonged to the Alaska Packers' Association of San Francisco. While being towed to sea by two tugs she was blown ashore and the tugs were obliged to cut loose to save themselves. The "Star of Bengal" was 263 ft. long with 40-ft. beam and carried a cargo of salmon.

THE U. S. CRUISER "YANKEE" struck on Spindle Rock, at the western entrance to Buzzard's Bay, near Newport, R. I., Sept. 23. The accident occurred during a fog early in the morning, and the vessel was so firmly fixed on the rocks that the efforts of several tugs to pull her off were unsuccessful. It is reported that the hull was perforated at several points on the port side, forward, and that nine frames were broken, all in one compartment. The damaged section is about 8 ft. above the keel and 36 ft. in length. The cargo of coal and part of the armament have been removed to other vessels to facilitate her removal from the rocks.

THE CHOLERA EPIDEMIC IN RUSSIA had resulted, up to Sept. 27, in reports of 15,863 cases and 7,102 deaths, of which 4,931 cases and 1,875 deaths have been reported as occurring in St. Petersburg, beginning Sept. 8. Cholera also prevails to a moderate extent at Manila, P. I., 14 cases and 3 deaths having been reported for the 24 hours ending at 8 a. m., Sept. 28.

ANOTHER FIRE AT CHELSEA, MASS., Sept. 21, inflicted a loss of $400,000, approaching in extent that of April 12, 1908. Starting in mill No. 1 of the box factory of Atwood & McManus, the flames, driven by a stiff breeze, swept over several acres in the lumber district on the northwest edge of the city. The burned district immediately adjoins that affected by the fire of April 12. It extends over the triangular area bounded by the Boston & Maine R. R., Everett Ave. and Carter St., and about 100 ft. beyond Carter St. between the railway tracks and Vale St. Besides the box factory, a large shoe factory, part of a lumber plant, a bottling plant and the Union Metal Co. were destroyed. Twenty families are reported homeless.

The Chelsea firemen were greatly handicapped in fighting the fire by lack of apparatus. A blown-out cylinder head, a broken pump and a broken wheel put three engines out of commission and left only one Chelsea engine in the field. An engine which had been sent over from Charlestown was abandoned, due to a sudden movement of the flames, and was heavily damaged.

THE DAM AT HENRY, ILL., on the Illinois River, was attacked with dynamite on the night of Sept. 22. The dynamite was placed near the connection of the dam with the lock wall, but fortunately no serious damage was done. The deed is attributed to the same parties who blew up the bank of the Illinois & Michigan Canal, 12 miles below Joliet, Ill., a few weeks ago. This was noted in our issue of Sept. 10.

FOREST FIRES IN THE ADIRONDACKS, under the influence of the strong south wind of Sept. 26 and 27, got beyond the control of the army of fire-fighters, and several small settlements and camps were burned. Long Lake West, a village of about 100 inhabitants, was completely destroyed. Among the buildings burned at this place was a large store-house in which were stored 100

bbls. of kerosene and 1,500 lbs. of dynamite. The villagers had been warned and were at a safe distance when the dynamite exploded. Twenty cars on the Mohawk & Malone R. R., a branch of the New York Central & Hudson River, were destroyed, and the tracks between Nehasane and Horseshoe for a distance of about twelve miles were injured by the flames to such an extent that no trains could pass over them. In the northern part of Clinton Co., N. Y., several thousand cords of pulp wood and many maple sugar groves were burned. For several days in New York State, 5,000 men were engaged in fighting the fires, and during this time more than 50,000 acres of timber land were burned over. The loss in this state will exceed $5,000,000. The Adirondack fires were checked by light rain Sept. 28, and the heavy rains of the 29th have practically eliminated the danger of further fires in that region.

In the northern section of New Jersey the loss from forest fires during the past ten days has been estimated at $100,000, borne chiefly by Sussex and Warren Counties.

In West Virginia, disastrous fires have been burning in the Cheat Mts. The coke ovens in the Deckers Creek valley and the Sabraton plant of the American Sheet & Tin Plate Co., employing in all about 2,000 men, were obliged to shut down on account of the drought.

Foster City, Dickinson Co., Mich., is reported to have been destroyed, Sept. 20, with a loss of six lives. The mill of the Morgan Cedar & Lumber Co. was among the buildings burned. Reports from Calumet, Mich., state that 800,000 ft. of standing timber have been burned in the iron region. The villages of Bark River, Delta Co., and Homestead, Benzie Co., have been burned. At the last-named place the charcoal kilns and lumber yards of Alex. Immerman & Co. were destroyed.

In Wisconsin, the village of North Forks, Price Co., was burned Sept. 21.

Traffic on the St. Lawrence River was almost entirely discontinued, Sept. 25, on account of the dense smoke from forest fires. Several collieries of the Dominion Coal Co. were shut down on account of the cessation of shipments. Twenty-two ocean steamers were said to be delayed in the river between Montreal and Quebec by the fog and smoke.

The fires throughout the country have been largely extinguished by the recent heavy rains.

ORVILLE AND WILBUR WRIGHT, the builders of the aeroplane whose recent performances and final wrecking at Fort Myer, Va., have been described in this journal, have been granted an extension of time, in which to present a complete machine, to June 28, 1909.

At Le Mans, France, Sept. 28, Mr. Wilbur Wright established a record for flight with one passenger of 11 min., 35⅘ sec.

THE FREIGHT-CAR SITUATION continues to improve, and at an increasing rate. The figures for Sept. 16 have just been published by the American Railway Association's committee on Car Efficiency, and they show a greater decrease in surplus cars during the two weeks from Sept. 2 to Sept. 16 than during any preceding period since the beginning of the slump in railway business. The idle cars on Sept 16 numbered 173,587 (a decrease of 49,045 in two weeks), of which about 59,000 were box cars and about 69,000 coal and gondola cars. During the two weeks, Sept. 2-Sept. 16, the decrease in idle box cars was 26,000, while the decrease in idle cars of all other types was 23,000. Thus box cars show not only the largest relative but also the largest absolute improvement.

The present course of the improvement, if continued, would wipe out the car surplus in about three months, i. e., before the close of the year. However, the normal excess of autumn traffic can hardly be expected to continue as long as this. In 1907 the increase in traffic began about the first of August and reached its culmination during the latter part of October. The present jump in cars in service is considerably sharper, and has already lasted as long as the upward-trending part of the 1907 fall period.

ABOUT $70,000,000 has been expended up to the present on the New York extension of the Pennsylvania R. R., including four tunnels under the East River between Long Island City and Manhattan, two double-track rock tunnels across Manhattan, the immense terminal station on Seventh Ave., two single-track tunnels under the Hudson River, two single-track rock tunnels through Bergen Hill, and the connecting line from the west portal of these tunnels to the Pennsylvania's main line a mile east of Newark. The completion of the project will require some $20,000,000 more, and will take until well along in 1910.

AN INJUNCTION against the discharge of sewage into the Delaware River by the city of Phillipsburg, N. J., has been applied for in behalf of the New Jersey State Board of Health, as successor to the State Sewerage Commission. The city did not obey an order of the Commission to stop discharging crude sewage into the river by Oct. 1, 1907

PERSONALS.

Mr. Charles H. Turner, Jun. Am. Soc. M. E., has entered the service of the Standard Steel Car Co., Butler, Pa., as a designer.

Mr. H. O. Cole, Assoc. M. Am. Soc. C. E., has been appointed Assistant Engineer in charge of office engineering on the Pacific Division of the Panama Canal.

Mr. J. Henry Sirich, Jr., Assoc. Am. Soc. M. E., formerly Turbine Engineer with the Westinghouse Machine Co., has joined the power department of the Bethlehem Steel Co.

Mr. W. E. Elam, Jun. Am. Soc. C. E., Engineer of the New Orleans Levee Board, has resigned that position and will be succeeded by Mr. Sidney F. Lewis, M. Am. Soc. C. E.

Mr. John R. Morgan, M. Am. Soc. M. E., formerly Mechanical Engineer of the Morgan Engineering Co., has become General Manager of the Calumet Engineering Works at Harvey, Ill.

Mr. E. A. McFarland, Chief Engineer of the Gila Valley, Globe & Northern Ry., has resigned. He will be succeeded by Mr. R. L. Drane, who graduated at the University of Arizona in 1903.

Mr. Carleton A. Read, M. Am. Soc. M. E., formerly Professor of Mechanical Engineering at New Hampshire College, has been appointed Professor of Steam Engineering at Worcester Polytechnic Institute.

Mr. C. N. Gould, Professor of Geology at the University of California, has been made Director of the Geological Survey of Oklahoma, of which Governor C. N. Haskell is President. Field studies of the oil fields have already been taken up.

Mr. E. J. Govern, M. Am. Soc. C. E., formerly Superintendent of Erection of the McClintic-Marshall Const. Co., Pittsburg, Pa., has opened a consulting and constructing-engineering office in the Granite Building, Rochester, N. Y.

Mr. F. P. Gutelius, Assistant Chief Engineer of the Canadian Pacific Ry., has been appointed General Superintendent of the Lake Superior division, succeeding Mr. F. P. Brady, who has resigned. Mr. J. G. Sullivan, Manager of Construction, will succeed Mr. Gutelius as Assistant Chief Engineer at Montreal.

Mr. Edmund M. Blake, of the firm of Blake & Symonds, Consulting Civil Engineers, 8 Beacon St., Boston, has been engaged by J. G. White & Co., Incorporated, of New York, to represent them in southern Idaho in connection with the management of the Idaho Irrigation Co., Ltd. The firm of Blake & Symonds will be maintained for the present at Boston.

Mr. W. G. Chace, Secretary of the Toronto Section of the American Institute of Electrical Engineers, has retired from that position, owing to his approaching departure for Winnipeg, Man. Mr. Chace was presented by the members with a handsome club bag, at the meeting of Sept. 19, in recognition of his interest in the work of the Section throughout the past two years.

Obituary.

Mr. M. McIntyre, of Detroit, Mich., has been appointed Superintendent of the San Francisco, Vallejo & Napa Valley Ry.

Mr. W. J. Hoskin, Master Mechanic of the Chicago Great Western Ry., has been appointed Master Mechanic of the Chicago & Alton R. R., at Bloomington, Ill.

Mr. William J. Wilgus, M. Am. Soc. C. E., has resigned his position as Consulting Engineer of the New York Public Service Commission for the First District. Mr. Wilgus was retained to assist the commission in solving the problem of the Eleventh Ave. track removal, New York City.

Leslie Carter, formerly President of the South Side Elevated R. R. Co. of Chicago, died in that city Sept. 25. Mr. Carter was born at Galena, Ill., in 1851, and graduated at Yale in 1873. From 1895 until the period of his last illness he was President of the Calumet & Chicago Canal & Dock Co.

Samuel H. Smith, at one time City Engineer of San Francisco, died at his home in that city Sept. 14 after an illness of several months. Mr. Smith was born at Washington, D. C., in 1853 and was educated at the University of Virginia. He went to California in 1878, having previously been engaged in river and harbor engineering in the East.

James Isaac Haycroft, Assoc. M. Am. Soc. C. E., of whose death at his home in Woollahra, New South Wales, Australia, April 11, a belated notice has just been received, died from hemorrhage of the brain after a two weeks' illness. Mr. Haycroft was born at Cork, Ireland, in 1853, and graduated at Queens College, Ireland, in 1882, as Master of Engineering.

Albert M. Bullard, Assoc. Am. Inst. E. E., died Sept. 19 at the Loomis Sanatorium in Liberty, N. Y. Mr. Bullard received his technical training at the Massachusetts Institute of Technology. He has been successively associated with the Thompson-Houston Co., at Lynn, Mass., the Chicago Telephone Co. and the Western Electric Co., and was best known for his work in the development of the electric welding process and the telephone.

William A. H. Allen, a retired chief engineer of the U. S. Navy, died at his home in Swarthmore, Pa., Sept. 23. Mr. Allen was born in New York. He was appointed a third assistant engineer from Pennsylvania in 1863 and was promoted through the successive grades until, in 1874, he became a passed assistant engineer. He was retired in June, 1890, for incapacity resulting from incident of service, and his rank was changed to chief engineer in June, 1906.

ENGINEERING SOCIETIES.

COMING MEETINGS.

ILLUMINATING ENGINEERING SOCIETY.
Oct. 6-7. Annual convention at Philadelphia, Pa. Secy., Van Rensselaer Lansingh, Engineering Societies' Building, 33 West 39th St., New York City.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.
Oct. 12-16. Annual convention at Atlantic City, N. J. Secy., B. V. Swensen, 29 West 39th St., New York City.

RAILWAY SIGNAL ASSOCIATION.
Oct. 13-15. Annual meeting at Washington, D. C. Secy., C. C. Rosenberg, 12 North Linden St., Bethlehem, Pa.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20-22. Annual convention at Washington, D. C. Secy., S. F. Patterson, Boston & Maine Ry., Concord, N. H.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.
Oct. 20-23. Annual meeting at Atlantic City, N. J. Secy., A. P. Folwell, 239 West 39th St., New York City.

AMERICAN GAS INSTITUTE.
Oct. 21-23. Annual meeting at New York City. Asst. Secy., W. Bissell, 29 West 39th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY.
Oct. 30-31. Fall meeting at New York City. Secy., Dr. J. W. Richards, Bethlehem, Pa.

ROADMASTERS AND MAINTENANCE-OF-WAY ASSOCIATION OF AMERICA.
Nov. 10-12. Annual meeting at Milwaukee, Wis. Secy., W. E. Emery, West Chicago, Ill.

AMERICAN RAILWAY ASSOCIATION.
Nov. 18. Annual meeting at Chicago, Ill. Secy., W. F. Allen, 24 Park Pl., New York City.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 19-20. Annual meeting at New York City. Secy., W. J. Baxter, 29 West 39th St., New York City.

AMERICAN INSTITUTE OF ARCHITECTS.
Dec. 15-17. Annual convention at Washington, D. C. Secy., Glenn Brown, "The Octagon," Washington, D. C.

WESTERN SOCIETY OF ENGINEERS.—At a meeting of the electrical section, held in the society's rooms at Chicago on Sept. 25, Mr. F. A. Sager described the electric traction equipment for the St. Clair tunnel of the Grand Trunk Ry. The tunnel passes under the St. Clair River, between Sarnia, Ont., and Port Huron, Mich. It is 6,032 ft. long, and the length of line equipped for electric traction is nearly four miles. This includes the approaches (with grades of 1% and 2%) and the connections with the passenger terminals and freight yards on either side. The tunnel has a single track, but the approaches are mainly double-track. The tunnel was originally operated by tank locomotives of the 0-10-0 class, but considerable trouble was caused by gas from the engines, and in some cases trainmen were suffocated when trains were stalled in the tunnel. To eliminate this danger, and to improve the efficiency and economy of operation with heavy traffic, it was decided to introduce electric traction.

The railway company engaged Mr. B. J. Arnold, of Chicago, as consulting engineer to investigate the matter. He reported in favor of the alternating-current system, but alternative plans were prepared for both this and direct-current. Bids were invited and a contract for the work complete was awarded to the Westinghouse Co. for a single-phase alternating-current equipment. The overhead wire conductor system is used, the wire being suspended from catenary cables hung between steel bridges at the wider parts of the line. The power-house is at Port Huron, and the generating plant consists of two Westinghouse-Parsons turbo-generator units. This plant also supplies current for the pumps which drain the tunnel and for the electric lighting of the tunnel, buildings, stations, yards, etc. An interesting feature is the method of handling the peak load by means of large water storage in the boilers and an automatically regulated forced draft. The locomotives are six-wheeled machines, but are normally operated in pairs, each pair forming a single unit. They have 62-in. driving wheels and weight about 65 tons. Each axle has a 250-HP. motor. The specified requirement was the hauling of a 1,000-ton train over the entire electric section in 15 minutes, but a 930-ton train has been handled in 11 minutes. The electric traction system has been in operation for a few months.

The paper was illustrated by numerous lantern slides of drawings and photographs. There was very little discussion, and this turned mainly on the possible advantages of using storage batteries to take care of the peak of the load when, as in this case, the peak is uniformly high.

CONSTRUCTION NEWS

Supplement to ENGINEERING NEWS. New York, October 1, 1908.

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CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(* *denotes that this work is advertised in Engineering News.*)

The following Plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

Bids close.	Work.	Place.	See issue.
10- 2	*Water-wks.,	Alleghany, N. Y.	(S.) 9-17
10- 3	*Macadam,	Atlanta, Ga.	(P. & S.) 10- 1
10- 3	Laundry (Mfg. Pl.),	Norfolk, Va.	(S.) 9-17
10- 3	Alternators,	Washington, D. C.	(S.) 9-17
10- 5	*Rock excavation,	Boston, Mass.	(S) 9-10
10- 6	*Water-Works,	Haddonfield, N. J.	(P. & S.) 9-17
10- 8	*Lift bridge,	Wash., D. C.	(S) 9- 3
10- 9	*Wharf, seawall,	Mobile, Ala.	(S.) 9-10
10-10	*Steel stack, boilers,	Boston, Mass.	(S.) 9-17
10-12	*Superstructure,	Cincinnati, O.	(P. & S.) 9-17
10-17	Wharf and dredging,	Norfolk, Va.	(S.) 10- 1
10-19	*Engine,	Houston, Tex.	(S.) 9-17
10-30	Pipe,	Passaic, N. J.	(S.) 10-17
12- 1	Dredging,	Hawaii	(S.) 9-17

LIST OF CONTRACTS PENDING.

LIGHT, HEAT AND POWER PLANTS.

10- 3 Alternators, Washington, D. C.. 9-17
10- 5 Elec. equip., Victoria, B. C..... 9-17
10- 5 Elec. equipment, New York.....10- 1
10- 7 Bridge lighting, New York.....10- 1
10- 8*Cable, etc., Boston, Mass..... 9-10
10- 9 Producer pl., Salt Lake City, U.10- 1
10-12 Elec. trolley system, New York..10- 1
10-17 Lighting fixtures, Wash., D. C.... 9-24
10-19*Wiring, etc., Ft. Monroe, Va....10-1

BRIDGES.

10- 2 Bridges, aulding, O 10- 1
10- 3 Bridge, Olympia, Wash 10- 1
10- 3 Piers, Ottawa, Kan 10- 1
10- 3 Bridge, Greencastle, Ind.....10- 1
10- 3 Substructure, Greenville, O.....10- 1
10- 3 Bridges, Norristown, Pa.. .....10- 1
10- 3 Bridge, Urbana, Ill..... 9-24
10- 3 Bridges, etc., Pawhuska, Okla... 9-24
10- 3 Bridge work, Cleveland, Ohio.... 9-17
10- 5 Bridges, Chickasha, Okla..... 9-24
10- 5 Abutments, Toledo, Ohio..... 9-24
10- 5 Bridge, Gaffney, S. C..... 9-24
10-5*Bridge plans, etc., Austin, Tex.... 9-10
10- 5 Bridge, Redwood City, Cal.....10- 1
10- 5 Bridge, Ontario, Ore 10- 1
10- 6 Retaining walls, Covington, Ind..10- 1
10- 6 Bridges, Petersburg, Ind. 10- 1
10- 6 Bridge, etc., Madison, Ind.....10- 1
10- 6 Bridge, Stevenson, Wash 10- 1
10- 6 Bridge, L'Original, Ont..... 9-10
10- 6 Bridges, Stockton, Cal..... 9-17
10- 6*Bridge, Ottawa, Ill..... 9-17
10- 7 Arch, Muncie, Ind 10- 1
10- 7 Bridge repair, Frankfort, Ind.....10- 1
10- 7 Bridge, York, Pa. 10- 1
10- 8 Bridges, Rushville, Ind 10- 1
10- 8 Bridge, etc., Indianapolis, Ind...10- 1
10- 8*Lift bridge, Wash., D. C..... 9- 3
10- 9 Bridge, Cincinnati, Ohio..... 9-17
10- 9 Bridge, Madisonville, Ohio..... 9-24
10- 9 Bridges, Manhattan, Kan..... 9-24
10- 9 Bridges, Brookville, Ind.....10- 1
10-12*Superstructure, Cincinnati Ohio. 9-17
10-12 Bridge, Princeton, Ind. 10- 1
10-17 Bridge, Amanda, O 10- 1
10-26 Bridge, Barstow, Cal 10- 1

BUILDINGS.

10- 2 Court-house, Pueblo, Colo..... 9-24
10- 2 Bldg., etc., Vancouver Bks., Wash 9-17
10- 2*Mail lift, Meriden, Conn. (Bldgs.) 9-17
10- 2 Laundry, etc., Spring City, Pa. (Mfg. Pl.) 9-17
10- 3 Laundry, Norfolk, Va. (Mfg. Pl.) 9-17
10- 5 Schools, New York, N. Y..... 9-24
10- 5 Post-office, Chippewa Falls, Wis. 8-27
10- 6*Vault, Washington, D. C..... 9-10
10- 8 Post-office, Hagerstown, Md..... 9-17
10- 8 Shops, St. Boniface, Man (Mfg. Pl.) 9-24
10- 8 Roofing, New York 10- 1
10- 8 Filling, Winnipeg, Man.(Mfg. Pl.)10- 1
10- 9 Quarters, Ft. Howard, Md..... 9-17
10-10 Post-office, Butte, Mont..... 8-20
10-10 Walls, etc., Paris, Ill..... 9-24
10-10 Building, Birmingham, Ala..... 9-24
10-14 Steel, Atlanta, Ga. 10- 1
10-15 Copper work, Atlanta, Ga.....10- 1
10-15 Plans, Indianapolis, Ind.....10- 1
10-15 Post-office, Marietta, Ohio..... 9-24
10-15*Quarters, Ft. Andrews, Mass..... 9-17
10-17 Court-house, Boston, Mass..... 9-10
10-19*Post-office, Porto Rico..... 9- 3
10-21 Engineering bldg., Ann Arbor, Mich. 10- 1
10-23 Quarters, Ft. Du Pont, Del. 10- 1
10-28 Sschool plans, Lynn, Mass. 10- 1
10-30*Post-office, Carthage, Mo..... 9-24
11- 1 School, Wilkinburg, Pa..... 9-10
11- 4 Buildings, No. Chicago, Ill. 10- 1
11- 5*Interior work, Cleveland, O.....10- 1

WATER-WORKS.

10- 2 Reservoir, Astoria, Ore..... 9-24
10- 2 Water-works, Kiowa, Kan..... 9-24
10- 2*Water-works, Alleghany, N. Y..10- 1
10- 5 Well, Harrisonburg, La..... 8-20
10- 5 Water-main, Grand Forks, N. D. 9-24
10- 5 Water-works, Shakopee, Minn...10- 1
10- 6 Pumping plant, Red Oak, Ia. 10- 1
10- 6*Boilers, Engines, Burlington, Ia.. 9-10
10- 6 Water-works, Hope, Ark..... 9-17
10- 6*W.-Works, Haddonfield, N. J... 9-17
10- 7 Pumping stations, etc., Brooklyn.10- 1
10- 7 Tower, Otoe, Okla 9-24
10-12*Filtration plant, Evansville, Ind. 9- 3
10-12 Water-works, Burlington, Colo..10- 1
10-14*Water supply, Kings Park, N. Y.10- 1
10-14 Cast-iron pipe, etc., Vancouver, B. C. 8-13
10-14 Water-pipe, Chagrin Falls, Ohio.. 9-17
10-15 Pumping sta., Brownwood, Tex..10- 1
10-19 Water-works, Oakland, Md.....10- 1
10-19*Engine, Houston, Tex..... 9-17
10-30 Water pipe, etc., Passaic, N. J.... 9-17

SEWERS.

10- 1 Sewer, Bloomington, Ill 10- 1
10- 2 Sewers, Altoona, Pa. 10- 1
10- 2 Sewers, Dayton, Ohio..... 9-24
10- 5 Sewers, Lawrence, Kan..... 9-24
10- 3 Sewers, Hamilton, O 10- 1
10- 5 Sewers, etc., Carroll, Ia 10- 1
10- 6 Sewer, Appleton, Wis.....10- 1
10- 6 Sewer, Oakley, O 10- 1
10- 6 Drain, Trenton, N. J. 10- 1
10- 6 Sewer, Cherokee, Iowa..... 9-24
10- 6 Sewers, Hope, Ark..... 9-17
10- 6 Sewers, Corlett, Ohio..... 9-17
10- 9*Sewer, Louisville, Ky..... 9-24
10-10 Sewer, Adams, Minn 10- 1
10-12 Sewer, Wabash, Ind 10- 1
10-12 Sewer, Jefferson, O 10- 1
10-14*Disposal plant, Baltimore, Md.... 9-17
10-15 Sewers, Pipestone, Minn. 10- 1
10-19 Sewer, Oakland, Md 10- 1
10-21 Sewer, Louisville, Ky 9-24
10-23 Drain, Fort Du Pont, Del. 10- 1
10-28*Sewers, etc., Rye, N. Y..... 9-24

STREETS AND ROADS.

10- 2 Grading etc., Fostoria, O.....10- 1
10- 2 Grading, etc., Olympia, Wash....10- 1
10- 2 Street Impvt, Dayton, O.....10- 1
10- 2 Paving, Youngstown, O. 10- 1
10- 3*Macadam, Atlanta, Ga..... 9-17
10- 5 Road, Liberty, Ind..... 9-17
10- 5 Roads, Crown Point, Ind..... 9-24
10- 5 Asphalt repair, New York..... 9-24
10- 5*Macadam, Westfield, N. J..... 9-24
10- 5 Paving, etc., Lawrence, Kan.....10- 1
10- 5 Grading, etc., Etna, Pa. 10- 1
10- 5 Paving, Erie, Pa 10- 1
10- 6 Road, Hartford City, Ind.....10- 1
10- 6 Road, Bloomfield, Ind 10- 1
10- 6 Road, Martinsville, Ind 10- 1
10- 6 Grading, etc., Columbus, O 10- 1
10- 6 Gutters, Bessemer, Ala. 10- 1
10- 6 Roads, Vincennes, Ind..... 9-24
10- 6*Paving, Bayonne, N. J..... 9-24
10- 6 Road, Clearfield, Pa..... 9-24
10- 7 Road, La Fayette, Ind..... 9-24
10- 7 Roads, Muncie, Ind..... 9-24
10- 7 Roads, Corydon, Ind..... 9-24
10- 7 Stone, Indianapolis, Ind. 10- 1
10- 9*Grading, etc., Charleston, W. Va.10- 1
10-10 Grading, Carthage, Ohio..... 9-17
10-10 Sidewalks, etc., Raleigh, N. C. .10- 1
10-12 Roads, Fort Thomas, Ky. 10- 1
10-14 Grading, etc., Cleveland, O. ...10- 1
10-15 Repaving, etc., New York, N. Y.10- 1
10-16 Road, Monticello, Ind. 10- 1
10-17 Road, Terre Haute, Ind. 10- 1
10-19 Macadam, etc., Haworth, N. J...10- 1
10-24 Road, Portland, Ind.....10- 1

MISCELLANEOUS.

10- 2 Dam, Dayton, O. 10- 1
10- 3 R. R. work, Carolina, Clinchfield & Ohio R. R. 10- 1
10- 3 Levee, Velasco, Tex..... 9-17
10- 5*Rock excavation, Boston, Mass.... 9-10
10- 5 Lumber, rails, Panama..... 9-17
10- 5 Dredge equipment, New Orleans, La 9-17
10- 5 Levee, Sacramento, Cal..... 9-17
10- 5 Sprinkling system, New York.. 9-24
10- 5 Drain, Rockwell City, Ia..... 9-24
10- 5 Ditch, Minneapolis, Minn. 10- 1
10- 6 Ditch, Flandreau, S. Dak. 10- 1
10- 7 Repairing boat, Baltimore, Md.... 10- 1
10- 7 Wall, Elmira, N. Y..... 9-24
10- 7 Cranes, Panama 9-17
10- 8 Ditch, Cerro Gordo, Ill..... 9-10
10- 8 Ry, trestle, etc., Canada (Rys.)..10- 1
10- 8 Ditch, etc., Oregon, Wis. 10- 1
10- 8 Smoke consuming device, Dayton, Ohio 10- 1
10- 9*Wharf, seawall, Mobile, Ala..... 9-10
10-10*Steel stack, boilers, Boston, Mass. 9-17
10-10 Track scale, Ft. George Wright, Wash. 9-24
10-10 Ditch, Elbow Lake, Minn. 10- 1
10-12 Derricks, railway supplies, Panama 9-17
10-13*Garbage, New York, N. Y. 10- 1
10-14 Levee, Vicksburg, Miss. 10- 1
10-14*Removing wreck, Portland, Me.. 9-17
10-14*Dredging excav., Chicago, Ill..... 9-17
10-16 Dredges, Panama 9-24
11-17*Lock and dam, Mobile, Ala..... 9-17
10-17 Wharf and dredging, Norfolk, Va.10- 1
10-19*Rock-crushing plant, Washington, D. C. 9-24
10-19 Levee work, Memphis, Tenn..... 9-24
10-21 Rails, ties, etc., Georgia (Rys.).10- 1
10-22 Lantern, New London, Conn. 10- 1
11- 2 Submarines, Wash., D. C. 8-13
11- 9 Battleships, Washington, D. C... 9-17
12- 1 Dredging, Hawaii 9-17

FOREIGN.

10- 6 Telegraph material, Australia... 9-10
10-14 Dredging, Spain 7-18
10-14 Tramway, Roumania 9-10
10-14 Ry. telegraph system, Brazil..... 9-17
10-15 Drydock, Italy 9-10
10-21 Power plant, Australia 9-10
10-20 Reservoir, Pipe, India 8- 6
11- 2 Electric plant, Chile..... 7-18
11- 2 Telegraph material, Australia..... 9-10
11- 4 Reservoir, India 8- 6
12- 1*Sewers, paving, Ecuador..... 8- 6

CIVIL SERVICE.

10- 7 Examiner of Accounts, Washington, D. C. 9-10
10- 7 Hydrographic Draftsman, Washington, D. C. 9-10
10- 7*W.-Works Insp., New York.....10- 1
10- 8 Elevator Insp., New York.....10- 1
10-14 Scient. Asst., Wash., D. C.....10- 1
10-17 Supt. of Bldgs., Wash., D. C....10- 1
10-17 Draftsman, Albany, N. Y.....10- 1
10-17 Inspector, Albany, N. Y.....10- 1
10-17 Health Officer, Albany, N. Y....10- 1
10-19 Highway Ry. and Irrig. Engr., Philippines 9-24
10-21 Mech. draftsman, Wash., D. C..10-24
10-21 Asst. designer, Wash., D. C.... 9-24
10-21 Forest Asst., Philippines..... 9-24

RAILWAYS.

ALBERTA RY. & IRRIGATION LINE.—See Canadian Pacific Ry.

ALBERTA SOUTHERN.—This company has been incorporated with $500,000 capital stock to build from Lethbridge, Alta., west to the boundary of British Columbia; also from Lethbridge northwest to Calgary; and from Macleod to a point on the Lethbridge-Calgary line, thence easterly to Medicine Hat. There will also be branch lines. Offices of the company will be at Calgary. The directors include I. S. G. Van Wart, R. J. Hutchings and A. M. Grogan, of Calgary.

AMADOR CENTRAL.—Articles of incorporation of the Amador Central R. R. Co. have been filed at San Francisco. The road is to run ten miles. Company is to acquire and operate the property of the Ione & Eastern R. R. Co., from Ione to Martell, near Jackson, Amador County. The capital stock of the new concern is $400,000, of which $15,000 is subscribed. The directors are: Frank J. Solinsky, Jr., Frank W. Wehe, Paul C. Morf, Philip Strubel, Talton Hawes, Joseph L. Scotchler and Fred. Hanak.

CALGARY & KNEEHILL.—Incorporated with $1,000,000 capital stock to build from Calgary, Alta., northerly to Kneehill Creek. Offices of the company will be at Edmonton, Alta. The directors include F. Aylwin, Ottawa, Ont.; P. Roy and J. E. Laurencelle, both of Edmonton.

CANADA.—Bids are asked by the Department of Indian Affairs, Ottawa, Ont., until noon, Oct. 8, for the following railway ties and timber: Lot 1, 25,000 cedar ties and 500 cords of shingle bolts, to be cut from dead and fallen trees by the Indians of Manitoulin Island, unceded part, during the ensuing winter, and delivered on the shore of Lake Huron at convenient points for shipment. Lot 2, 10,000 cedar, tamarack and hemlock ties, to be taken out by the Indians of Garden River Band during the ensuing winter, and delivered on the banks of Echo River, Garden River, Root River and St. Mary's River. Any further information desired will be given on application to C. L. D. Sims, Indian Agent, Manitowaning, Ont., for Lot 1; M. L. Nichols, Indian Agent, Sault Ste. Marie, Ont., for Lot 2; or, for both lots, to J. D. M'Lean, Secy., Dept. Indian Affairs, Ottawa.

CANADIAN PACIFIC.—This company has bought the Alberta Ry. & Irrigation Co.'s property in South Alberta, it is stated, and plans to make the Crows' Nest Pass route its main freight line to the Pacific Coast.

Surveys are in progress locating a line through Pine Pass, in the Rocky Mountains; also a line to Dunvegan, on the Peace River, B. C. Pine Pass, next to Yellow Head Pass, where the Grand Trunk Pacific is going through, is the easiest route to the Pacific coast.

CAROLINA, CLINCHFIELD & OHIO.—Bids are asked by MacArthur Bros. Co., Spartanburg, S. C., until 1 p. m., Oct. 3, for 31 miles of railroad work on this railroad between Spartanburg, S. C., and Bostic, N. C., as follows: 2,000,000 cu. yds. steam shovel and team work; 35,000 cu. yds. concrete masonry. Pile and trestle bridges, etc. Work will be divided in sections to suit contractors' outfits, which can complete the respective sections in five months. Some team work in connection with steam shovel work. Masonry mostly at important river crossings. Profiles and further information can be obtained at company's office, Spartanburg, S. C. This project was noted fully on March 19.

GEORGIA.—Bids are asked by R. V. La Dow, Supt. Prisons and Prisoners, Dept. Justice, Washington, D. C., until 10 a. m., Oct 21, for furnishing and delivering at the United States Penitentiary, Atlanta, Ga.: (a) steel rails, angle bars, rail braces, tie plates and spikes; (b) 110 ties, 7-in. by 9-in. by 8 ft., treated with creosote, in accordance with specifications.

GRAND TRUNK PACIFIC.—Official announcement is made that regular train service was inaugurated on Sept. 21 on this line between Winnipeg and Wainwright, Alta., a distance of 666 miles. It is the first section of the new Canadian transcontinental to be put under the operating department.

Contracts have been awarded for building sections of the trans-continental railway as follows: MACDONELL & O'BRIEN, Montreal, Que., have received contracts for building sections 1 and 2, as follows: (1) District C.—From a point near Weymontachene, Que., 196 miles west of the north abutment of the Quebec bridge, which point is on the boundary between Districts C and D, west for about 107 miles. Date of completion, Dec. 31, 1910. (2) District C.—From a point about 107 miles west of Weymontachene, west to the end of the Grand Trunk Pacific contract, about 115 miles. Date of completion, Dec. 31, 1910.

O'BRIEN & McDOUGALL, Ottawa, Ont., have received contracts for building sections 5 and 6, as follows: (5) Districts E and F.—From a point at the western end of Fauquier Bros.' contract north of Lake Nepigon, Ont., to a point at or near Dog Lake, about 126 miles. Date of completion, September 1, 1910. (6) District F.—From a point at or near Dog Lake, Ont., to a point at or about mile 2.6 west of Peninsula Crossing, by alternative routes as shown on the plans, about 23.76 miles by the northerly route, and 24.13 miles by the southerly route, the selection of the route to be at the option of the Commissioners. Date of completion, Sept. 1, 1910. Bids were received on Aug. 20. Noted on July 30.

IONE & EASTERN.—See Amador Central R. R.

MATONE & GASPE.—We are officially advised that clearing and grading has been started and the first two miles will be graded and track will be laid this fall and substructure will be built for a bridge over the Metis River. About 30 miles will be completed next summer. R. E. Hunter, Ste. Flavie, Que., is Ch. Engr. and Supt. of Const. H. J. BURMER CO., 42 Broadway, New York, has the general contract.

MEXICO.—The Mexican Central Ry. Co., Ltd., is now having a reconnoissance made of the grade of its road from Irapuato to Guadalajara with the view of eliminating curves and, if possible, to reduce the mileage between those points. As yet no report has been made by the engineering corps now in the field. S. M. Felton is Pres.; and L. Kingman is Ch. Engr., Mexico City, Mex.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—It is planned to complete the line connecting Brooten and Duluth, Minn., during 1909. This line is 189 miles long. On account of the financial stringency during the early part of the year the company was unable to provide funds to carry on construction of this section. During the latter half of 1907, 50 miles of line were built and an additional 50 miles have since been finished. For this extension and for the acquisition and improvement of suitable terminals at Duluth, money has now been secured by the sale of bonds and capital stock.

QUEBEC CENTRAL.—We are officially informed that contracts probably will be let this fall for building an extension from St. George Beauce to St. Justine, following the valley of the Famine River, 30 miles. Surveys are made and capital secured. Right-of-way is now being obtained. J. K. Morkill is Ch. Engr., and T. H. Walsh is Gen. Mgr., Sherbrooke, Que.

SOUTHERN PACIFIC.—Engineers, under Wm. Ashton, Ch. Engr., Salt Lake City, Utah, are reported to be making survey for the Farmington-Wheeler Cañon cut-off.

TEXAS SOUTHEASTERN.—Survey is being made for building an extension from Kennard to Crockett, 18 miles. J. E. Mitchell, Ch. Engr.; E. C. Durham, Mgr., both at Diboll, Tex.

WICHITA FALLS & NORTHWESTERN.—Contract has been awarded to the J. E. KIRKES CONSTRUCTION CO., Oklahoma City, Okla., for the construction of 20 miles of this railroad from Randlett, Okla., to Emerson. The route north from Emerson is undecided at present. Estimated cost, $200,000.

ELECTRIC RAILWAYS.

NEW YORK, N. Y.—See item under Light and Power Plants.

BABYLON (L. I.), N. Y.—Thomas L. Hughes, Pres., 5 Nassau St., New York, writes us that "the Suffolk Traction Co.'s route extends from Babylon on the west, to Brookhaven on the east about 27 miles along the south shore, and from Patchogue northerly across Long Island to Port Jefferson, 13 miles, making about 40 miles of railroad. The route extends along the south shore on both public and private right-of-way, through West Islip, Islip, Bay Shore, East Islip, Oakdale, West Sayville, Sayville, Bayport, Blue Point, Patchogue, East Patchogue, Bellport and Brookhaven, and from Patchogue directly north across the Island on almost exclusive private right-of-way to Port Jefferson. Franchise grants from public authorities and consents of property owners have been secured for the entire route. Condemnation proceedings have been instigated preparatory to securing portions of the right-of-way in the middle of the Long Island."

ROSLYN (L. I.), N. Y.—We are advised by Charles H. Clark, Ch. Engr., Roslyn, that the New York North Shore Traction Co. will build an extension from Mineola to Hicksville, N. Y. It is to be a single track and overhead trolley system. Distance, 6¾ miles.

EAST AURORA, N. Y.—Henry C. Jewett, East Aurora, who is secretary and treasurer of the proposed company which will build a short electric line here, advises us that contracts probably will be let some time next year for construction work. Company plans to build a large hotel here and the electric line will connect the hotel and the Jewett Covered Mile Track with the Pennsylvania R. R. It will be 2½ or 3 miles long. Noted on July 30.

PATERSON, N. J.—We are officially advised that the contract for constructing a line for the North Jersey Traction Co., to be built between Paterson and Suffern was awarded on Sept. 22 to JOHN R. LEE, of Paterson, and 170 Broadway, New York. The line, which will be 15 miles long, is to be finished, according to the terms of the contract, in four months, and will be a trolley system. This is to be the first section of an electric line to be built later between Hoboken and Paterson by a separate concern known as the New York & New Jersey Rapid Transit Co., as soon as the needed capital can be obtained. No contracts have been awarded as yet.

The President of the Paterson-Suffern line is William Barber, of Paterson, and the Vice-President is Malcomn R. McAdoo, of Montclair. The total cost of the new line, it is estimated, will be $500,000. Work will be begun next week, but it is thought that the cold weather intervening may prevent the completion of the road till May. A large amount of stock has been sold. It is intended that the proposed extension by the New York & New Jersey Rapid Transit Co. between Paterson and Hoboken shall be a third rail system. Elevated structures will be placed over all crossroads and wherever the line crosses the tracks of the Erie R. R. The road will connect with the tunnels of the Hudson & Manhattan R. R. Co. Noted on Aug. 27.

JOHNSTOWN, PA.—The formation of the Johnstown & Gallitzin Street Railway Co. is announced and the concern has started on a project which will entail the expenditure of at least $1,250,000. Wallace Sherbine, of Wilmore, is Pres. of the company. The total length of the line will be 32 miles. Johnstown and Gallitzin will be the terminal points.

GASTONIA, N. C.—A franchise has been granted to W. S. Lee and L. C. Harrison for an electric street railway. Mr. Lee is Vice-Pres. and Gen. Mgr. of the Charlotte Power Co. and Mr. Harrison is assistant secretary of the same. The company proposes to build an electric railway connecting various points.

FERDINAND, IND.—THOMAS GLYNN has been awarded the contract for the construction of the Ferdinand R. R. Co.'s line between Huntingburg and Ferdinand. This is a short distance out of Evansville. It is proposed to begin work next month. D. H. Morgan, Indianapolis, is Secy. Noted on Sept. 10.

INDIANAPOLIS, IND.—A request of the Indianapolis Traction & Terminal Co. for permission to lay double tracks in Meridian St., between McCarty and Palmer Sts. and for the abandonment of its single track in Union St., the return route of the Meridian St. car line, was granted by the Board of Public Works on Sept. 25. R. I. Todd is Vice-President and Gen. Mgr., Indianapolis.

GOSHEN, IND.—The directors of the Kendallville, Ligonier & Goshen Interurban R. R. Co., recently incorporated, will ask for bids soon for the construction of 40 miles of road. E. E. McCray, Pres.; C. C. Bayer, Secy.

BLUFFTON, IND.—We are advised that a trolley road, 40 miles long, will be built in the spring between Bluffton and Celina, Ohio. B. A. Batson, Bluffton, is Consult. Engr.

STREATOR, ILL.—Contract has been let to H. L. HOSSACK, of Ottawa, Ill., for grading for an interurban line to connect Grand Ridge and Streator. The work of grading for the line between Grand Ridge and Streator will begin at Grand Ridge.

DES MOINES, IOWA.—The Des Moines, Council Bluffs & Western Ry. Co., of Des Moines has been incorporated to build a line from Council Bluffs to Des Moines, with an extension to Muscatine, with $100,000 capital stock. Incorporators: Robert Pilmery, Norwalk, Iowa; N. W. Hansen, Haslith, Iowa; R. S. Bannister, Des Moines, and A. P. Sawyer, of Pierre, S. Dak.

OMAHA, NEB.—The Omaha, Council Bluffs & Des Moines Ry. Co. has been incorporated to build an electric line from Omaha, Neb., east to Des Moines, Iowa. The proposed line will be from Omaha to Council Bluffs, Iowa, thence northeast through Shelby to Harlan and then east, between the lines of the Chicago, Milwaukee & St. Paul and the Chicago, Rock Island & Pacific, through Audubon, Guthrie Center, Dale, Redfield, Adel and to Des Moines. J. W. Russell is Pres., Adel, Iowa; F. M. Hopkins, Vice-Pres., Guthrie Center, Iowa; H. H. Miller, Secy., Fort Dodge; E. L. Lockwood, Treas. Financial arrangements have been completed for constructing this line.

UVALDE, TEX.—We are officially advised that a street car line, the equipment for which will be operated by gasoline motors, is proposed and a contract has been let for the construction to the WEBER-DULLER CONSTRUCTION CO., Houston, Kearby & Smith, of Austin, have the franchise for a public utility of this kind in Uvalde. It is to have three miles of track in the town of Uvalde, covering the various sections of the town. The contract involves an expenditure of about $30,000. Work is to commence by Oct. 1 and the contract to be completed by Dec. 1. It is to be a solid roadbed of heavy iron.

AUSTIN, TEX.—The Austin Electric Ry. Co. will build a belt line along the east side of the Capitol grounds. Other track extensions are contemplated. W. H. Burdett, Austin, is Supt.; W. J. Jones, Austin, is Gen. Mgr.

GAINESVILLE, TEX. — The Gainesville, Whitesboro & Sherman Electric Ry. Co. has awarded the general grading contract to O'REILLY, CALLAHAN & GIVEN of Chicago. The TENNY CONSTRUCTION CO., Silver City, N. Mex., is the sub-contractor. The line is completed twelve miles out from Gainesville. The railway will connect Gainesville and Sherman and will be 39 miles long, eventually. Surveys are made and right-of-way secured. John King, Gainesville, is Pres.

SAN FRANCISCO, CAL.—The Parkside Realty Co., Crocker Bldg., has let contracts for the completion of its entire railway system on 20th Ave., T St., 35th Ave., and the Sloat Boulevard to Ingleside to CHADWICK & SYKES, Crocker Bldg., for $200,000, street and sewer work to cost about $800,000 more. The railway will be double tracked throughout with terminals at the beach and at Ingleside. For the present it will connect with the United Railroads at H St., but later the cars will run down town. The sewer system to be installed will cover the southern half of the Sunset District and the street work will cover about ten miles of roadway.

SAN LUIS OBISPO, CAL.—A party of engineers in charge of Harry McRay, of Bakersfield, Cal., has begun surveys of the route of the proposed electric railway between San Luis Obispo and Cambria. The line, as it is now planned, is to run from Cambria to Pizmo via Cayucos, Morro, Chorro alley, San Luis Obispo and Oilport.

GOLDFIELD, NEV.—According to the Goldfield "Tribune," plans are being formed to construct an electric street railway here. The directors will include George Wingfield, Denny Sullivan, T. F. Manning and Senator H. V. Morehouse. The system will cost in the neighborhood of $125,000.

LIGHT AND POWER PLANTS.

(denotes that this work is advertised in Engineering News.)*

*BOSTON, MASS.—Guy C. Emerson, Supt. of St., of the city of Boston, 47 City Hall, invites parties having street lighting apparatus adapted to system other than the present system of low pressure gas mantles to demonstrate, if they so desire, during the continuance of the present contract for street lighting, with a view to the improvement of the present system upon the expiration of the present contract on Sept. 15, 1909.

ANDERSON, MASS.—We are advised by C. J. R. Humphreys, Vice-Pres., that the statement, in the issue of Sept. 3, that the Lawrence Gas Co., Lawrence, Mass., intends to construct an electric lighting system in Andover is incorrect.

POUGHKEEPSIE, N. Y.—See item under Albany, N. Y.

MIDDLETOWN, N. Y.—See item under Albany, N. Y.

NEW YORK, N. Y.—Bids are asked until Oct. 5 by C. B. J. Snyder, Supt. School Bldgs., Dept. of Education, for installing electric equipment in new public school No. 157, on the west side of Kent Ave. and the east side of Taaffe Pl., about 247 ft. south of Park Ave., Boro. of Brooklyn.

Bids are asked until 2 p. m., Oct. 7 by J. W. Stevenson, Comr. of Bridges, for the installation of the Electric wiring, lamps, fixtures, etc., for the lighting of the Blackwell's Island Bridge, over East River, between the Boroughs of Manhattan and Queens.

NEW YORK, N. Y.—The following bids were received on Sept. 24 by the Park Board for all labor and materials required for changes in electric circuit work, fire alarm and watchman's detector system, night lighting system, changes in elevators, etc., for the Metropolitan Museum of Art: T. Frederick Jackson, 592 Columbus Ave., $35,919; E. J. Duggan, 1133 Broadway, $35,883; Lord Electric Co., 213 West 40th St., $41,983; Reis & O'Donovan, 1123 Broadway, $32,460; L. K. Comstock & Co., 50 Church St., $39,500; J. Livingston, Jr., & Co., 113 East 22d st, $35,000; Cowder & De Young, 1123 Broadway, $39,808; M. B. Foster Electric Co., 27 West 27th St., $41,600.

NEW YORK, N. Y.—Bids are asked until 2 p. m., Oct. 12, by J. W. Stevenson, for furnishing and installing the electrical equipment for the overhead trolley system of the Blackwell's Island Bridge over the East River, between the Boroughs of Manhattan and Queens.

BINGHAMTON, N. Y.—See item under Albany, N. Y.

ALBANY, N. Y.—The following bids were received by the State Commission in Lunacy on Sept. 23, for the construction of conduit for Acute Hospital, including steam piping, at the Hudson River State Hospital, Poughkeepsie: Edward Joy, 133 Market St., Syracuse, N. Y., $14,000; Edward P. Bates, 310 Broadway, Albany, N. Y., $13,500; John W. Danforth Co., 70 Ellicott Sq., Buffalo, N. Y., $13,447; Peter Keeler Building Co., 468 Orange St., Albany, N. Y., $14,632. R. T. Ford Co., 200 South Ave., Rochester, N. Y., $15,900.

On the same day the following bids were received by the Commission for the construction of conduit, including steam piping, for the Acute Hospital at the Binghamton State Hospital, Binghamton, N. Y.: G. N. Guest, New York, $9,676; Edward Joy, Syracuse, N. Y., $9,282; John Dyer, Jr., Albany County Bank Bldg., Albany, N. Y., $8,470; R. T. Ford Co., Rochester, N. Y., $9,800; John W. Danforth Co., Buffalo, N. Y., $7,498.

Bids were also received for construction of conduits for Nurses' Home and Farmer's House, including steam piping, and electric cables, at the Middletown State Hospital, Middletown, N. Y., as follows: Watertown Construction Co., Watertown, N. Y., $20,824; R. T. Ford Co., Rochester, N. Y., $18,978; John W. Danforth Co., Buffalo, N. Y., $18,790.

Bids were also received on same day for boilers, heater, tank and piping at the Long Island State Hospital, Flatbush, Brooklyn, as follows: Edwin Burhorn, 71 Wall St., New York, $12,448; James Curran Mfg. Co., 52 West 36th St., $9,000; Edward Joy, Syracuse, N. Y., $8,997; E. Roessler Co., New York, $8,173; Griscom-Spencer Co., 90 West St., New York, $7,500; Christopher Cunningham, Greenpoint Ave., Brooklyn, $9,859; W. B. Armstrong, Albany, N. Y., $9,690; the G. & W. Mfg. Co., 26 Cortlandt St., New York, $8,243; The R. T. Ford Co., Rochester, N. Y., $9,300; Boyd Equipment Co., New York, $8,500; Wells & Newton Co., New York, $7,735. T. E. McGarr is Secy. of the Lunacy Comn.; F. B. Ware is State Arch.

BROOKLYN, N. Y.—See item under Albany, N. Y.

BEAVER, PA.—The College Hill residents have decided that the electric light plant which was wrecked by the explosion of the boilers some time ago, should be rebuilt by the borough and that it should continue under municipal ownership. The proposed plant will cost $15,000, and full equipment, including boilers, dynamos, generators, switchboards, etc., will be required. James Harper is Surv.

WASHINGTON, D. C.—Bids were opened at the office of Elliott Woods, Supt. of the U. S. Capitol Bldg. and Grounds, on Sept. 9 for furnishing a number of special electric lighting fixtures for the Senate office building as follows: J. B. McCoy & Son, 114 West 30th St., New York, $20,544 and $25,000; Cassidy & Son. Mfg. Co., 133 West 23d St., New York, $24,872; Sterling Bronze Co., 107 West 25th St., New York, $18,706; Black & Boyd Mfg. Co., 23 East 23d St., New York, $25,000. C. A. Muddiman & Co., 1204 G St., Washington, D. C., Item 1, furnish and install fixtures as illustrated, $13,395; Item 2, substitute design, N. 5,120 with choice of design 4,832, Eagle Arms, $14,495; Item 3, same as bid 2, but substituting rich cut glass cornered prisms instead of U-shaped prisms, $16,055; Item 4 is the same as No. 3 except that it increases the spread of crystal chandeliers, making them six inches wider, $17,615; Item 5, the same as bid 3, but increases the spread of the crystal chandeliers 12 inches, $19,175. All of the bids include the crystal chandeliers lengthened out with heavy plated lengthening. To each of these bids add $3,000 to include the lengthening by prismatic chain extending all the way to the ceiling.

*FORT MONROE, VA.—Bids are asked by Capt. Ernest R. Tilton, Constr. Q. M., until 10 a. m., Oct. 19, for heating, wiring and electrical fixtures for one double set N. C. O. quarters; and plumbing, wiring and electrical fixtures for two double sets Firemen's quarters, at Ft. Monroe, Va.

CHATTANOOGA, TENN.—The Chattanooga-Tennessee River Power Co., Anthony Brady, New York, N. Y., Pres., has awarded contract to GUILD & CO., of Chattanooga, to furnish material and construct transmission line 15 miles long for conveying power from Hale's Bar to Chattanooga. Steel towers resting on concrete foundations will be erected at several points along right-of-way. The contract involves expenditure of about $150,000. Company is constructing water-power-electrical plant at Hale's Bar, securing ultimate development of 56,000 HP. John Bogart, 115 Broadway, New York, N. Y., is Engr.

MOUNT VERNON, OHIO.—The contract for the electrical equipment of the Ohio State Sanatorium at Mount Vernon, Ohio, has been awarded to the ELECTRICAL SUPPLY & CONSTRUCTION CO., 80 East Gay St., Columbus, Ohio, for about $30,000. Mark Simonton is Pres. and Gen. Mgr. of the Electric Supply & Construction Co.

CINCINNATI, OHIO.—The Cincinnat Electric Light & Power Co. has obtained permission to tear down a 1-story brick boilerhouse and a 1-story brick waiting-room on the south side of Eastern Ave., between Foster and St. Andrews Sts., and to add to the East End power plant. A boiler plant will be constructed and a smokestack 200 ft. high will be erected. The company has obtained permission from the Federal Government to insert an intake pipe in the Ohio River back of the power plant for water, and also to construct a coal elevator. Walter A. Draper is Secy.; Dana Stevens is Gen. Mgr.

MORGANTOWN, IND.—It is reported that the Morgantown Light & Power Co., recently incorporated, will ask for bids soon for the construction and equipment of a light and power plant.

ROCKFORD, ILL.—Plans are being considered by the Rockford Water Power Co. for the construction of a concrete dam to replace the present one at this point, or to repair the leaks in it. In the former case an expenditure of $100,000 would be entailed, while reconstruction of the old one would amount to from $25,000 to $30,000. Among those interested in the project are George D. Roper and Charles S. Brantingham.

GREAT FALLS, MONT.—The Great Falls Water Power & Townsite Co. is doing preliminary work at Big Falls, where the Missouri River makes a perpendicular drop of 96 ft. About 50,000 HP. will be developed. The company has established an office for its engineering and construction department in the office buildings of the old Silver Smelter and will maintain the same during the construction of the Rainbow Falls dam. Frank Scotten will have charge of the construction work.

GLASGOW, MONT.—The contract for the construction of the municipal electric light works has been awarded to W. D. LOVELL & CO., 1415 Southeast Eighth St., Minneapolis, Minn., for $13,500.

SPRINGFIELD, MO.—Plans are being prepared for the installation of a central heating and lighting plant for heating and lighting the Drury College buildings and also to supply electricity for lighting the campus. The cost of the plant is estimated at $20,000. Dr. George Baldwin is P[illegible]

SAN RAFAEL, CAL.—T[illegible] Water Power Co., intend[illegible] Snow Mountain from Gravely Valley, thr[illegible] bring the water a tunnel into Potter Valley, thence down[illegible] iew Cloverdale, at which place it would [illegible] water out for irrigation purposes only. [illegible] is proposed to establish a power plant a[illegible] mouth of the tunnel in Potter Valley.

SALT LAKE CITY, UTA[illegible]—Bids are asked until 8 p. m., Oct. 9, by t[illegible] Board of Public Works, for constructing [illegible] brick building for suction gas producer [illegible] H. G. Millan is Chn.; Louis C. K[illegible] is City Engr.

PORT ARTHUR, ONT.—G. Chace, of Smith, Kerry & Chace, Con[illegible] Engrs., Confederation Life Bldg., Toro[illegible] Ont., writes us that "the city of Port [illegible]hur, Ont., is supplied with electricity [illegible] its municipal light and railway utilities [illegible] from a water power at the mouth of t[illegible] current River about three miles east of t[illegible] centre of the city. The demands for the [illegible] utilities have so increased that it became necessary some three or four years ago to [illegible]te a storage reservoir on the stream for the purpose of increasing the dry season's supply of water to the power plant. Three suitable lakes have been formed by means of dams thrown across the channel of the stream and are now in service. A fourth reservoir was located about three miles east of the city. The dam is 22 ft. high was built partly upon rock and partially upon gravel hard pan. Although considerable care was taken in the absence of ny expert engineering advice, the dam failed soon after the reservoir had been filled. The sudden flood caused by the release of this stored water did considerable damage to the lower channel of the river and especially at the service reservoir dam at the power plant. The services of C. B. Smith, of Smith, Kerry & Chace, Toronto, were requisitioned and on his advice a concrete structure is now to be built after plans developed by that firm. This new dam incidentally will raise the level of the service reservoir giving considerable greater peak load capacity to the electric power plant. The disaster above referred to exposed a very considerable surface within the City Park in which the reservoir and power plant are located and the new dam is so designed as to accommodate to this condition by the use of a very long over fall crest surmounted by a series of neat arches supporting a footwalk. The contract for its construction has been let, at price within the engineer's estimates, to SEAMAN & PENNIMAN, who will proceed at once with its construction. Under the advice of the engineer, the city will proceed to reinforce two of the storage dams on this river and the contract for reinforcement of the principal dam, that at Onion Lake, was let recently on plans by the above mentioned firm."

BRIDGES.

(denotes that this work is advertised in Engineering News.)*

NORRISTOWN, PA.—Bids will be received until Oct. 3 by the County Commissioners, Norristown, Robt. C. Miller, Clk., for repairing and reconstructing a highway bridge over Skippack Creek near mainland in Township of Lower Salford; also same time and place for constructing a stone arch highway bridge over Skippack Creek in Skippack Township. John H. Dager is Engr.

YORK, PA.—Bids will be received until Oct. 7, by the County Commissioners, York, C. B. King, Clk., for constructing the substructure and superstructure of a bridge across Codorus Creek near Porter's Siding, substructure to consist of two stone abutments, two wing walls, one 25 ft. and the other 23 ft. long, the superstructure to be of steel 84 ft. long, 14 ft. roadway and a capacity of 1,750 lbs. per lin. ft.

SCRANTON, PA.—The PENN BRIDGE CO., Beaver Falls, Pa., has secured contracts at $10,515, for constructing the Prospect bridge and at $6,571 for No. 14 bridge in Port Griffith.

MONACA, PA.—The McKELVEY-HINE CO., 248 Fourth Ave., Pittsburg, Pa., has been awarded the contract at $20,000, for constructing a 50-ft. concrete arch over Pennsylvania Ave. for the Pittsburg & Lake Erie R. R. Co.

CUMBERLAND, MD.—The Baltimore & Ohio R. R. Co. will widen the viaduct, extending from Hay to Cumberland Sts. through its entire length with concrete, masonry and brick . Estimated cost, $75,000. A. H. Griffith, Wheeling, W. Va., is Engr.

CECIL, W. VA.—The BRACKETT BRIDGE CO., Skillman Road, Cincinnati, Ohio, has been awarded the contract at $6,734 for erecting the superstructure of a steel bridge across Tygarts Valley River at Cecil. The structure to be of high truss pattern, with two spans, each 175 ft. long. Contracts for masonry and other work will be awarded later.

HUNTINGTON, W. VA.—Bids are asked by the County Court of Cabell County until noon, Oct. 7, for the construction of the substructure and superstructure of a bridge across the Guyandotte River, to be erected upon one or the other of the locations afterwards to be decided upon by the County Court. One location across the Guyandotte River at the town of Barboursville, and the second, across the Guyandotte River near the town of Barboursville at Thornburg's Ford. F. F. McCullough is Clk.

CHERAW, S. C.—The city will rebuild the bridge over the Pee Dee River, probably of steel. John D. Smith is Chn. Bridge Com.

PELZER, S. C.—The CHATTANOOGA BRIDGE CO., Chattanooga, Tenn., has been awarded the contract at $3,635 for constructing a steel bridge here, replacing the structure destroyed by recent flood. The bridge will be erected jointly by Anderson and Greenville Counties.

HONEA PATH, S. C.—The ROANOKE BRIDGE CO., Roanoke, Va., has been awarded the contract at $5,400 for rebuilding County's bridge over Saluda River, about six miles from here. It will be a steel structure, two 136 × 12-ft. spans; steel joist; concrete on masonry piers; 54-ft. approach.

PAULDING, OHIO.—Bids will be received until Oct. 2, by the County Commissioners, Paulding, J. S. McKanna, Chn., for constructing seven concrete and one steel bridge. C. L. Straw is County Surv.

GREENVILLE, OHIO.—Bids are asked until Oct. 5, by James R. Marker, County Surv., for the construction of the substructure for a 120-ft. span bridge over Stillwater Creek in Richland Township.

ELVIRA, OHIO.—We are officially advised that S. MENDELSON has been awarded the contract for furnishing 6,000 cu. yds. of earth filling for the new East Broad St. bridge. Bids were opened on Sept. 21. Rose Moriarty is City Clk.

AMANDA, OHIO.—Bids are asked until 11.30 a. m., Oct. 17, by the County Commissioners, Lancaster, Ohio, for the steel superstructure of a bridge across Clear Creek about one mile west of here. H. C. Belt is Clk. Comrs.

*CINCINNATI, OHIO.—Plans and specifications are on file at the office of Engineering News, New York, for the construction of the superstructure of a viaduct for the terminal track of the Cincinnati Southern Ry., from Eighth St. and McLean Ave. to Third and Front Sts. Bids are asked until noon, Oct. 12. Ward Baldwin is Ch. Engr.

INDIANAPOLIS, IND.—Bids are asked by the Commissioners of Marion County until 10 a. m., Oct. 8, for the construction of a bridge over White Lick Creek, Wayne Township; for a concrete culvert in Center Township; for a high-truss bridge over Little Eagle Creek, Wayne Township; and for a bridge over Doe Creek, Franklin Township. Albert Sahm is County Audr.

BROOKVILLE, IND.—Bids are asked by the Commissioners of Franklin County until 2 p. m., Oct. 9, for the construction of two arch bridges and approaches. Charles A. Miller is County Audr.

PRINCETON, IND.—Bids are asked by the Commissioners of Gibson County until 11 a. m., Oct. 12, for the construction of a steel bridge.

RUSHVILLE, IND.—Bids are asked by the Commissioners of Rush County until 2 p m., Oct. 8, for the construction and repair of nine bridges. A. L. Winship is County Audr.

MADISON, IND.—Bids are asked by the Commissioners of Jefferson County until 1 p. m., Oct. 6, for the construction of two concrete walls, 100 and 120 ft. long; also for the construction of one 20-ft. beam girder bridge and one 110-ft. concrete girder bridge. G. F. Crozier is County Audr.

PETERSBURG, IND.—Bids are asked by the Commissioners of Pike County until 2 p. m., Oct. 6, for the construction of two steel bridges. F. R. Bilderbach is County Audr.

COVINGTON, IND.—Bids will be received by Commissioners of Fountain County until 1:30 p. m., Oct. 6, for the construction of concrete retaining walls and wings for two bridges. W. B. Gray is County Audr.

RICHMOND, IND.—The Commissioners of Wayne County will soon ask for bids for the construction of seven bridges, one in Dalton, two in Perry, two in Center and two in Wayne townships.

GREENCASTLE, IND.—Bids will be received until Oct. 8 by the County Commissioners, Greencastle, for constructing the substructure and superstructure of a bridge including approaches. D. V. Moffett is County Audr.

FRANKFORT, IND.—Bids are asked until 2 p. m., Oct. 7, by the County Commissioners for furnishing material and labor for repairing various bridges. C. F. Cromwell is County Audr.

*MUNCIE, ILL.—Bids are asked until Oct. 7 by the Commissioners for the construction of a reinforced-concrete arch of 80 ft. span and 16 ft. roadway over Stoney Creek, one-half mile east of Muncie, Ill. Plans and specifications may be seen at the Recorder's office, Danville, Ill., and at the office of W. F. Spear, Town Clk., Fithian, Ill. J. F. Fisher is Engr.

MILWAUKEE, WIS.—Two bids for the completion of the Grand Ave. viaduct were submitted to the County Board Committee on Sept. 18, as follows: The National Engineering & Construction Co., $372,000 (the contract price of the Newton Engineering Co.), allowing for work already completed; James O. Howard, Chicago, $345,000, allowing for work already done.

OTTAWA, KAN.—Bids are asked until noon, Oct. 3, by W. M. Staley, Trustee, care County Commissioners, County Court-House, for constructing stone piers for bridge over Walnut Creek in Peoria Township.

GREAT FALLS, MONT.—The County Commissioners on Sept. 15 opened bids and awarded contracts for constructing the Hound Creek Bridge, the Sun River Bridge approaches and the Truly Bridge to the MIDLAND BRIDGE CO., Gibralter Bldg., Kansas City, Mo., at $6,476, $3,229 and $10,490, respectively.

OLYMPIA, WASH.—Bids will be received until Oct. 2 by the Secretary of the State Highway Commission for the construction of a wooden bridge across Stevens Creek on the line of Sate road No. 9.

STEVENSON, WASH.—Bids will be received until Oct. 6 by the County Audr. for a 150-ft. wooden truss bridge across Woodward Creek.

ONTARIO, ORE.—Bids are asked until Oct. 5 by the Bridge Commission, J. A. Lackey, Chn., for the construction of a combination steel and wooden bridge across Snake River about one mile east of Ontario. The bridge will be about 800 ft. long and 20 ft. wide and will have three spans 150 ft. in length each. Estimated cost, about $20,000.

REDWOOD CITY, CAL.—Bids will be received by the Board of Supervisors until 10 a. m., Oct. 5, for the construction of an arch bridge of concrete on the Pescaders Fifth Road District of the County of San Mateo. Joseph H. Nash is Clk. Bd.

BARSTOW, CAL.—Bids will be received by the Board of Supervisors of San Bernardino, San Bernardino County, until 11 a. m., Oct. 26, for the construction of a bridge over Mojave River about one-quarter mile north of City of Barstow, in First Road district, San Bernardino County. The bridge will have a total length of 200 ft. center to center of end piers and consist of one through pin connected 10-panel truss bridge resting on concrete bulkheads.

COEUR D'ALENE, IDAHO.—Bids were received as follows by the County Commissioners on Sept. 17, for the construction of a bridge at Post Falls, bridge to be 1,445 ft. long with a 140-ft. steel span and built with concrete piers, having steel cylinder tubes: CARSCALLEN BROS., steel piling, $6,800; steel tube, $7,600; combined steel tube, $7,300; combined piling, $6,500 (awarded contract); Midland Bridge Co., combined piling, $6,775; steel piling, $7,375; steel, steel tubes, $11,795; Minenapolis Steel Co., steel steel tubes filled concrete, $9,883; Columbia Bridge Co., steel tubes filled, $8,884; combined pile pier, $6,784.

BUILDINGS.

(denotes that this work is advertised in Engineering News.)*

AUGUSTA, ME.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, has rejected all bids recently received for the construction of a post-office building at Augusta, Me., as in excess of the appropriation.

SPRINGFIELD, MASS.—See items under Sewerage.

LYNN, MASS.—Plans and specifications are asked until noon, Oct. 28, by the Board of School Commissioners, Charles H. Spear, Secy., for a 3-story brick school to contain 51,750 sq. ft. and to cost $85,000.

BOSTON, MASS.—An apartment house is to be erected at the junction of Huntington and Longwood Aves. and St. Alphonsus and Ward Sts. The building is to be constructed for Israel Nesson, 101 Tremont St., from plans of Nathan Douglas, Arch. The structure is to be five stories in height above the basement, and will contain 76 suites. The materials include granite and Indiana limestone and brick, with the interior finish in quartered oak and white enamel. There will be passenger and freight elevators. The lot faces 125 ft. on Hunting Ave., 100 ft. on Longwood Ave., 107 ft. on St. Alphonsus St. and 26 ft. on Ward St. Cost, $275,000.

SCHENECTADY, N. Y.—We are officially advised that the contract for constructing the proposed Center St. school has been let to BROWN & LOWE, of Schenectady. H. F. Miller is Secy. Bd. of Contract and Supply.

NEW YORK, N. Y.—Bids are asked until 3 p. m., Oct. 8, by the Park Board, Henry Smith, Pres., for all the labor and materials required for furnishing and laying new slag roofing and other work in connection therewith on the 86th St. stables and shops in Central Park, and new tile roofing on the comfort station in Morningside Park.

R. F. Almirall, 51 Chambers St., Arch for the Trustees of Bellevue and Allied Hospitals has filed plans with the Building Superintendent for the hospital for patients with tuberculosis to be built by the city on Blackwell's Island as an annex to the Metropolitan Hospital. It is to be 291 ft. long, with an extension, and will be four stories high, with spacious verandas surrounding each story. It is to be built of the local island stone, ornamented with bluestone trimmings. It will have a roof garden extending the entire length of the building, with a large solarium near either end. The structure is to cost $250,000.

Benjamin N. Duke, of the American Tobacco Co., has retained C. P. H. Gilbert, Arch., 1123 Broadway, to build a residence at the corner of Fifth Ave. and 89th St. The building will occupy a plot 60 × 100 ft., and the exterior will be of classic design and will be 6½ stories high.

The following bids were received on Sept. 17, by John F. Ahearn, Pres. Boro. of Manhattan: for repairs and alterations to, and the material and labor required for alterations in rooms on sixth and seventh floors; also for extension to the electric lighting equipment; for carpentry and cabinet work, hardware, metallic and other furniture, painting, electric lighting fixtures, marble and bronze work, plastering, fireproofing and other work in the Hall of Records Building, New York: Neptune B. Smythe, 1123 Broadway, $68,430; A. J. Rock, $89,977; JOHN COLLINS, 50 Church St., $56,700; William Werner, 892½ Forest Ave., $66,554; Wallace Larrer Co., $91,950; Remington & Sherman Co., 359 Broadway, $68,150.

Plans have been filed for two 8-story apartment houses to be built on 113th St., 475 ft. east of Broadway, for Paterno Bros., Inc., 54 Morningside Ave. W. They are to be of brick, trimmed with limestone and terra cotta, in the Renaissance style, with ornamental balconies at a number of the windows. Each will have a frontage of 149.11 ft., and a depth of 85.11 ft. They will cost $300,000.

BRIDGETON, N. J.—Bids were received as follows Sept. 29 at the office of the Supervising Architect, Treasury Dept., Washington, D. C., for the construction of a post-office building at Bridgeton, N. J.: Wilmarth Bldg., Co., New York, $45,945; Ambrose B. Stannard, St. James Bldg., New York, $55,300; Cramp & Co., Commonwealth Bldg., Philadelphia, $51,140; W. H. Fissell & Co., New York, $49,953; Sax & Abbott Construction Co., Philadelphia, $46,809; William T. Holding, 2426 Davison Ave., New York, $44,900; David Peoples, Philadelphia, $48,987; Lynch Bros., Philadelphia, $47,540; M. P. Wells, Philadelphia, $48,870; University Construction Co., New York, $60,000; Charles McCaul, Philadelphia, $49,987; J. E. & A. L. Pennock, Philadelphia, $50,487; Henry E. Baton, Philadelphia, $50,800; George A. Glenn & Co., Philadelphia, $44,944; R. C. Ballenger & Co., Philadelphia, $51,473. Time to complete, Dec. 1, 1909.

HOBOKEN, N. J.—Plans for the $400,000 Public Service Corporation traffic terminal at Hoboken have been approved by Thomas N. McCarter, Pres., and the Executive Committee of the corporation, and contracts for the work will be awarded and operations will be begun at once. The terminal is to be built of steel, concrete and glass, and will have a frontage of 400 ft. on Hudson St., with a width varying from 100 ft. at the widest part to 60 ft. where the building approaches the Lackawanna terminal. It will be two stories in height, with tracks on both ground and second floors. There will be four stairways to the Hudson River tunnels and entrances from Hudson St. A bridge will connect the terminal with the Deaware, Lackawanna & Western station. Leading from the second story there will be balcony stairways extending to the sidewalk on each side of Hudson St. R. E. Danforth, Newark, N. J., is Gen. Mgr.; D. G. Knight is Supt. of Bldgs., Passaic Wharf, Newark.

PATERSON, N. J.—Bids for the proposed School No. 23, which is to be located on the Colt's Hill tract, being on Grand and De-Grasse Sts. and adjoining the Children's Day nursery, will cost the city nearly $150,000, were opened by the Building Committee of the Board of Education on Sept. 16. The bids were: Mason, carpenter and iron work: A. B. Van Houten, $97,350; Leonard Breen Building Co., $97,768; Nicholas Tania, $101,300; Wm. L. Pratt Construction Co., $98,114; Steele & Hooper, $102,220; David Henry Building Co., $96,983; P. S. Van Kirk Co., $91,863; Feix G. Pittet, $99,500. The lowest bids received on the various sections of the work were: P. S. Van Kirk Co., Fulton St., Paterson, mason, carpenter and iron work, $91,863; Moshier & Kenna, 61 Broadway, Paterson, painting work, $3,100; C. R. Newman, 17½ Home Ave., Passaic, N. J., electrical work, $1,129; A. J. Rogers Co., 90 Broadway, Paterson, plumbing and heating work, $14,558; Leslie, Elliott & Co., East Railway Ave., Paterson, boiler work, $1,591.

MEADVILLE, PA.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of a post-office building at Meadville, Pa., to M. P. WELLS, Witherspoon Bldg., Philadelphia, at $77,437.

MERCER, PA.—The lowest bid received on Sept. 21 by Owsley & Boucherle, Archs., Wick Bank Bldg., Youngstown, Ohio, for the erection of a court-house to be erected here at a cost of about $300,000, was submitted by W. W. Luyster, of Dayton, Ohio. The building will be 92 × 180 ft., three stories in height, and constructed entirely of stone. It will contain a central steam heating plant and electric light plant.

PHILADELPHIA, PA. — GEORGE F. PAYNE & CO., 401 South Juniper St., have been awarded a contract for rebuilding the suburban home of George W. Elkins at Elkins Park, which was struck by lightning and burned last spring. Both the original house and the new structure were planned by Horace Trumbauer, Arch., Land Title Bldg.

Henry G. Dagit, Arch., 435 Chestnut St., has started plans for a 3-story parochial school building for St. Edward's Roman Catholic congregation, Rev. C. J. Vandergrift, Pastor. Estimated cost, $100,000.

GETTYSBURG, PA.—The Gettysburg Battlefield Memorial Commission, care C. Mulholland, Philadelphia, is receiving competitive plans for a 1-story Soldiers' memorial building to be erected at Gettysburg at a cost of $150,000.

WILLIAMSPORT, PA.—WILSON & BIERKAUMPER, of Kittanning, Pa., have secured contract at about $75,000, for erecting a dormitory for the State Normal School.

PITTSBURG, PA.—We are officially advised that the Henry Shenk Co. has awarded to the GEORGE KELLOGG STRUCTURAL CO., Builders' Exchange, Buffalo, N. Y., the structural steel and ornamental iron work for the United States Marine Hospital at Pittsburg, Pa.

PITTSBURG, PA.—The plans of Kiehnel & Elliott, Archs., 209 Ninth St., Pittsburg, have been accepted by the city for the insane hospital to be built at Marshalsea. The building will cost about $100,000. Among those on the committee are George W. Guthrie, Mayor, and J. P. Shaw, Dir. Charities Dept. Dr. S. L. Dixon is State Health Supt.

The Trustees of the Carnegie Institute have awarded contract to W. F. TRIMBLE & SONS CO., 1719 Greenwood Ave., Pittsburg, at $89,284, for constructing the proposed Carnegie library at Lang and Hamilton Aves. The style will be Gothic. The building will be 140 ft. square and the material brick and limestone. Alden & Harlaw, Farmers' Deposit Bank Bldg., are Archs.

LOCK HAVEN, PA.—The ALTOONA CONSTRUCTION CO., of Altoona, Pa., has secured the contract, at $50,168, to rebuild the Lock Haven hospital.

WASHINGTON, D. C.—Bids were received as follows on Sept. 22, at the office of Wood, Donn & Demings, Archs., Washington, for the construction of a laboratory building for the Bureau of Standards, Department of Commerce and Labor, Washington, D. C.: Newman & Smith, Colorado Bldg., Washington, $190,495; Pavarini & Wyne, Munsey Bldg., $156,000; Thompson-Starrett Co., Commercial National Bank Bldg., $145,900; Burgess & Parsons, Philadelphia Ave., $163,000; George A. Fuller & Co., Munsey Bldg., $153,700; John McGregor, 729 Twelfth St. N. W., $163,149; Brennan Construction Co., 3056 K St., $151,900; Cramp & Co., Commonwealth Bldg., Philadelphia, $151,987; J. E. & A. C. Pennock, Land Title Bldg., Philadelphia, $141,987; Noel Construction Co., Baltimore, $143,200; Norcross Bros. Co., Colorado Bldg., $172,139; John Gill & Sons, New York, $167,000. All bidders of Washington, D. C., unless otherwise specified.

A permit has been issued for a 9-story granite office building to be erected for the Evans Estate at 1417 New York Ave., N. W., at a cost of $266,000. Frederic B. Pyle, 1003 F St., N. W., is Arch. The contract has been awarded to the GEORGE A. FULLER CO., Munsey Bldg.

FORT DU PONT (Delaware City post-office), DEL.—Bids are asked until 11 a. m., Oct. 23, by the Constructing Quartermaster, U. S. A., Fort DuPont, for construction of three brick buildings (one 2-company barrack, one band barrack and one double firemen's quarters) including plumbing, heating and electric wiring at Fort DuPont, Del.

BALTIMORE, MD.—Walter B. McCardell, Law Bldg., has had plans prepared by John R. Forsythe, 232 St. Paul St., Baltimore, for 28 dwellings to be built on Appleton St. Each building will have two stories; buff brick and terra-cotta; electric lights; combination fixtures; hot-air heating. Cost, $70,000.

Charles E. Spalding of the Charles E. Spalding Co., 215 Courtland St., will erect 57 residences. They will have facades of Pompeiian brick with terra-cotta trimmings, slate and Spanish tile mansard roofs, with dormer windows on third floor, bay windows on second floor and marble and stone porches on first floor; dining-rooms to have heavy beam ceilings; living-rooms paneled in hardwood; hot-water heat; tiled bathrooms with mosaic floors; laundries in basements. Cost, about $500,000.

DALTON, GA.—Bids were received as follows, Sept. 28, at the office of James Knox Taylor, Arch., Treasury Dept., Washington, for the construction of a post-office building at Dalton, Ga.: Nashville Bldg. Co., Nashville, Tenn., $44,912; J. F. DePree, Rome, Ga., $47,178; Miles & Brodt, Atlanta, Ga., $38,600; Algernon Blair, Montgomery, Ala., $38,246; Windham Bros. Construction Co., Birmingham, Ala., $41,600; Gude & Co., Atlanta, Ga., $39,400; S. J. Warner, Atlanta, Ga., $44,000; Geo. Becking, Chatanooga, Tenn., $43,899. Time, Oct. 1, 1909.

ATLANTA, GA.—Bids are asked until 10 a. m., Oct. 14, by R. V. LaDow, Supt. Prisons and Prisoners, Dept. of Justice, Washington, D. C., for furnishing and delivering at the U. S. Penitentiary, Atlanta, Ga. 630 pieces Bessemer steel 1¼-in. in diameter by 11 ft. 6 ins. long; also bids are asked until 10 a. m. Oct. 15 for putting in place all copper work such as roof gutters ridge and ventilators for two guard towers on the enclosing wall of the U. S. Penitentiary at Atlanta Ga.

FRANKFORT KY.—The State Board of Control for Charitable Institutions has let contract to ALFRED STRUCK CO. of Louisville Ky. at $44000 for the erection of buildings for the Feebie Minded Institute. Albert Scott Pres.; D. X. Murphy & Bro. are Archs. Louisville.

GREENVILLE OHIO.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, has awarded contract for the construction of a post-office building at Greenville, Ohio, to SMITH & SHERRICK, Lima, Ohio, at $30,390. Time, Sept. 15, 1909.

ASHTABULA, OHIO.—We are officially advised that plans have been prepared by Briggs & Nelson, Rose Bldg., Cleveland, Ohio, and John Wilson, Ashtabula, Archs., for a 3-story club and gymnasium building, 50 × 133 ft., for the Y. M. C. A., Ashtabula, to cost $57,000. Contract for foundation work has been let to E. A. TAYLOR, Ashtabula, and for sewer work to F. E. SMITH. The balance of the work will be let next year.

CANTON, OHIO.—Contract has been let to KELLER E. HUFF, at $58,791, for erection of the proposed engine and police patrol building to be built here.

*CLEVELAND, OHIO.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Nov. 5, for the interior finish of the U. S. post-office at Cleveland.

TOLEDO, OHIO.—Bids are asked until 3 p. m., Nov. 10, by James Knox Taylor, Superv. Arch., Washington, D. C., for the construction of the U. S. post-office at Toledo.

INDIANAPOLIS, IND.—Plans will be received until Oct. 15 for the erection of a city hall building on the city's property at the corner of Ohio and Alabama Sts., at a cost of about $600,000. Charles G. Davis is Chn. Bldg. Com.

ANN ARBOR, MICH.—We are officially advised that on Sept. 24, the following contracts were awarded for constructing the proposed Chemical Laboratory building for the University of Michigan Building: H. L. VANDER HORST, Kalamazoo, Mich., $179,850; wiring, HENRY NEWGARD & CO., 30 West Monroe St., Chicago, Ill., $12,200; heating, SCHUMACHER & BACKHAUS, Ann Arbor, $35,687; plumbing, SPROUL & McGURRIN, Grand Rapids, Mich., $18,182. Hinch & Grylis, 710 Washington Arcade, Detroit, Mich., are Engrs. and Archs.

Bids are asked until 10 a. m., Oct. 21 (postponement from Sept. 22) by the Board of Regents of the University of Michigan at Ann Arbor, for erecting an addition to the Engineering Building. Albert Kahn is Arch., 58 Lafayette Boulevard, Detroit. Ithirley W. Smith is Secy.

NORTH CHICAGO, ILL.—Bids are asked until noon, Nov. 4, by J. E. Pillsbury, Ch. Bureau of Navigation, for the construction of six buildings consisting of a Commandant's house, four officers' houses, and a receiving guardhouse, at the Naval Training Station, Great Lakes, North Chicago, Ill.

CHICAGO, ILL.—According to the Chicago "Post," work on the architects' specifications for the proposed city hall has been completed and bids will be advertised for about Oct. 1. According to the present plans the new municipal building will be completed by Dec. 1, 1910, and the block between Clark, Washington, La Salle and Randoph Sts. will be covered with an 8-story building of outward construction uniform with the present county building. Those in charge of construction are Paul Redieske, Deputy Comrs. of Pub. Works; Holabird & Roche, Archs., Monadnock Bldg.; E. C. and R. M. Shankland, Rookery Bldg., engineering experts on the iron and steel work, and John M. Ewen. The bids will be advertised for at once and 30 days will be given for the firms to figure on them. The contract cannot be awarded until November, or early in December. The successful bidder will have until April 1 in which to prepare for the construction work. The contract with W. J. Newman, who is wrecking the old city hall and sinking the caissons for the new building, does not expire until that time. Estimated cost, $4,000,000.

A 3-story building to cost $70,000 is to be erected at 58th St. and South Park Ave., for Wills & Smith, 5938 South Halsted St. T. McCall, Railway Exchange, is Arch. The building will be 100 × 168 ft.

KENOSHA, WIS.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract to J. P. CULLEN CO., Janesville, Wis., for the construction of a post-office at Kenosha, Wis., at $51,665. Time, Dec. 1, 1909. A list of bids was published on Sept. 17.

GREEN BAY, WIS.—We are officially advised that the general contract for construction of the proposed 3-story Brown County court-house, 98 × 158 ft., has been let to the GENERAL CONSTRUCTION CO., Hathaway Bldg., Milwaukee, at $192,000. Contracts for heating and plumbing have been let to MARTIN & WIGMAN, Green Bay, at $6,880, and to GEORGE F. REEKE, Green Bay, at $4,700, respectively. C. E. Bell, Northwestern Bldg., Minneapolis, Minn., is Arch. The structure will be fireproof, of Bedford stone construction and will cost $225,000. Elmer S. Hall is County Clerk.

ST. PAUL, MINN.—The Board of School Inspectors has awarded first prize in the competitive designs for the Mechanic Arts High School to be built at Central Ave. and Robert St., to Rankin, Kellogg & Crane, 1012 Walnut St., Philadelphia. It will be a 3-story pressed brick and cut stone building, semi-fireproof. Dr. C. Fry is Pres. of the Board. Cost, $275,000.

LAWRENCE, KAN.—The Board of Regents of the University of Kansas have awarded the contract for the Engineering Building to the BLANCHARD CONSTRUCTION CO. for $41,000. This is the contract for the Mining Engineering Building which is to be erected this fall between the general engineering building which has just been completed and the Robinson gymnasium. The building, when finished, will resemble the Law Building in general architecture and will be built of native stone. The building will be two stories with a high basement. The basement will contain the work rooms and laboratories. The first floor will contain the mineralogical and geological museum and the offices of the instructors will also be on this floor. The second floor will be given over to laboratories and class rooms. F. Strang is Pres.

ST. LOUIS, MO.—We are officially advised that the Women's Christian Association has had plans prepared by J. Hal Lynch, Seventh and Locust Sts., St. Louis, for a blind girls' home, 100 × 142 ft., brick, with stone and terra cotta trimmings; terra cotta roof; electric lights to cost $60,000. The contract has been awarded to R. A. ANDERSON & CO.

PORTLAND, ORE.—W. L. Morgan, Arch., McKay Bldg., Portland, has in preparation plans for an apartment house of four stories, with basement. It will be erected in King St., between Washington and Wayne Sts., and will cost about $40,000. It will be erected for the Hanover Building Co., and will contain 30 3-room apartments. It will be of brick veneer and stucco construction.

SAN FRANCISCO, CAL.—We are officially advised that the WEBSTER-MACE CONSTRUCTION CO., Merchants' Exchange Bldg., San Francisco, has been awarded the general contract to construct a 5-story Class A, stone building for the Bankers' Investment Co., Union Trust Bldg. The building will be 100 × 100 ft. of ornamental iron work and glazed brick construction and will cost $200,000. William Mooser, Union Trust Bldg., is Arch.

A steel frame, Class A, building will be erected by H. Liebes & Co., 440 Van Ness Ave., on the site of the former Liebes building, on the south sile of Post Ave., between Kearney St., and Grant Ave.. Plans for the new building have been completed by Albert Pissis, Arch., James Flood Bldg., contracts are being let for the construction, and grading has commenced on the lot. The building will be six stories high, the steel frame being made strong enough to carry three additional stories, which will be built when conditions call for more space. The lot has a frontage of 53 ft. and a depth of 122 ft. and 6 ins. running through to Union Sq. Its front will be done in white limestone. The woodwork of the interior will be of white cedar, and marble will be used for wainscoting. Liebes & Co. contemplate occupying the basement, ground floor, galleries and one or more of the upper floors. The rest of the building will be arranged for offices, with special equipment for physicians and dentists. Construction will begin at once, and will be finished by next summer. The cost will be about $150,000.

A building soon will be started on a lot on the north side of Post St., 100 ft. east of Stockton St., with a frontage of 122 ft. Mrs. Russell Wilson, who owns the lot, has selected Clinton Day, Arch., Union Trust Bldg., to prepare plans. The building will be two stories high and will cost between $60,000 and $70,000.

WELLAND, ONT.—The contract for the public buildings here have been awarded to NAGLE & MILLS, of Ingersoll, Ont., at $56,526.

WATER SUPPLY—IRRIGATION.

(denotes that this work is advertised in Engineering News.)*

BENTON, N. H.—The Board of Trustees of the State Sanitarium for Consumptives, Concord, on Sept. 11, awarded the contract for building the dam and the laying of 4,000 ft. of pipe at the proposed Sanitorium at Glencliffe, in the town of Benton, to the OSGOOD CONSTRUCTION CO., of Nashua, at $7,000.

WEST SPRINGFIELD, MASS.—The Board of Water Commissioners on Sept. 17 awarded the contract for additional pumping equipment at Bear Hole to the WALSH BOILER & IRON WORKS, of Springfield, Mass., at $7,900. F. A. Barbour, of Boston, Mass., is Engr.

MEDFORD, MASS.—The contract for furnishing the city with one carload of 6-in. and one carload of 8-in. c. i. water pipe, bids opened Sept. 21, has been awarded to R. D. WOOD & CO., 400 Chestnut St., Philadelphia, Pa. Fred L. Cushing is Water Registr.

*STAMFORD, CONN.—A. B. GRISWOLD, of Hartford, Conn., has been awarded the contract by the Stamford Water Co., 125 Atlantic St., Stamford, for the construction of a dam, together with other work necessary to the enlargement of the reservoir, at $103,045. Bids were opened on Sept. 10. List of bidders noted on Sept. 17.

*KINGS PARK, N. Y.—Bids are asked until 3 p. m., Oct. 14, by the State Commission in Lunacy, Capitol, Albany, for the extension of the water supply system at the Kings Park State Hospital. Drawings and specifications may be consulted and blank forms of proposal obtained at the Kings Park State Hospital, Kings Park, N. Y., or at the office of the State Architect. Complete sets of plans and specifications will be furnished to prospective bidders upon reasonable notice to, and in the discretion of Franklin B. Ware. State Arch., Albany, N. Y. T. E. McGarr is Secy. Comn.

BROOKLYN, N. Y.—Bids will be received until 2 p. m., Oct. 7, by John H. O'Brien, Comr. Water Supply, Gas and Electricity, New York, for furnishing, constructing and erecting new pumping stations; also furnishing, delivering and erecting new pumping plants, complete, at Smith's Pond, Clear Stream and Valley Stream, Long Island, Borough of Brooklyn.

NEW YORK, N. Y.—Bids were opened on Sept. 17 by the Park Board, Henry Smith, Pres., for furnishing materials and laying water pipe in Bronx, Claremont, Crotona, St. Marys and Van Cortlandt Parks, Bronx Borough. The lowest bid was that of John B. Malatesta, 3169 Jerome Ave., at the following prices: 1,000 cu. yds. rock excavation, $3; 19,600 lin. ft. 3-in water pipe, 87 cts.; 5,800 lin. ft. 1-in. water pipe, 45 cts. Total, $17,000. Other bidders were: Atlanta Construction Co., $23,437; Henry E. Fox, $18,895; Goodman Contracting Co., $27,110; Haggerty Construction Co., $19,934; McHarg-Barton Co., $19,370; William H. Masterson, $19,055; Wilton Construction Co., $19,712.

FLUSHING (L. I.), N. Y.—The following bids were opened on Sept. 21 by C. B. J. Snyder, Supt. School Bldgs., New York, for installing a water supply system for the buildings of the Parental School here: Frank J. Fee, $17,981; GEORGE E. GIBSON & CO., 511 Park Ave., New York, $13,-997 (awarded contract); Nicholas Nehrbauer, Jr., $18,773; Patrick Sullivan, $19,750; William C. Ormond, $16,600.

NEW YORK, N. Y.—Bids were received on Sept. 16 as follows by John H. O'Brien, Comr. Water Supply, Gas and Electricity, for dismantling and removing the two batteries of two horizontal return tubular boilers each, and their appurtenances, from the boiler room of the 98th St. pumping station, and dismantling and removing two Stirling water tube boilers and their appurtenances now located in the incineration plant at the Delancey St. end of the Williamsburg bridge, and reerecting these two Stirling boilers, together with their foundations, setting steam and auxiliary piping and all other appurtenances complete in the boiler room of the 98th St. pumping station, Borough of Manhattan: Phoenix Construction Co., 41 Park Row, $10,997; Edward Butharn, $12,-640; E. Rutzler Co., 127 White St., $15,775; F. McSweegan & Sons, Dover St. and Franklin Square, New York, $10,290.

*ALLEGHANY, N. Y.—We are officially advised that the date for receiving bids for the construction of water-works here has been extended from Sept. 29 to Oct. 2.

*HADDONFIELD, N. J.—Plans and specifications are on file at the office of Engineering News, New York, for the construction of water-works. Bids are asked until Oct. 6.

JERSEY CITY, N. J.—The contract for cleaning 20,000 lin. ft. 20-in. c.-i. water pipe, bids opened Sept. 21, has been awarded to the NATIONAL WATER MAIN CLEANING CO., 27 William St., New York, at 50 cts. per lin. ft. George T. Bouton is Clk., Bd. of Street and Water Comrs.

BLOOMFIELD, N. J.—The U. S. CAST IRON PIPE & FOUNDRY CO., 71 Broadway, New York, has been awarded the contract for 10,000 ft. of water pipe at $23.30 per ton of 2,000 lbs. William L. Johnson is Town Clk.

NEWARK, N. J.—The contract for furnishing c.-i. pipe and special castings, bids opened Sept. 17, has been awarded to WARREN FOUNDRY & MFG. CO., New York, N. Y., at $31,532, the pipe to be high pressure pipe, part with w. i. bands on hub. M. R. Sherrerd is Ch. Engr., Dept. Pub. Wks.

*READING, PA.—Bids were received as follows on Sept. 22 by the Water Board for the construction of slow sand filters for the Maiden Creek water supply: Gore Engineering & Contracting Co., New York $215,-280; A. G. Vermilye, New York, $288,762; L. H. Focht & Son, Reading, $188,476; Nolan Bros., Reading, $195,412; Millard Construction Co., Philadelphia, $224,918; Fehr & O'Rourke, Reading, $190,663; David B. Peoples, Philadelphia, $220,264; United Ice & Coal Co., Harrisburg, $214,956; Bowman Bros. Co., New York, $281,472; Hawman Construction Co., Reading, $239,576; Mac Arthur Bros. Co., New York, $296,328; Joseph P. O'Reilly, Reading, $280,436; New York Continental Jewell Filtration Co., New York, $228,329; Howard E. Ahrens Co., Reading, $182,886; R. A. Maline & Sons, Lancaster, $224,910; Bunting-Bull Co., Flushing, N. Y., $263,815; Clement King Co., New York, $273,681; R. C. Storrie, Philadelphia, $257,059; Stanley Morrissey Co., New York, $201,455; S. W. Chiles, South Bethlehem, $210,513. For c.-i. pipe and special castings: Drummond Iron Works, Ltd., $19,834; U. S. Cast Iron Pipe & Foundry Co., $18,038; Camden Iron Works, $18,508; Donaldson Iron Co., Emaus, Pa., $19,976. For gate valves for slow sand filter plant: Kennedy Valve Mfg. Co., Elmira, N. Y., $3,582; Darling Pump & Mfg. Co., Williamsport, $3,346; Camden Iron Works, Camden, $4,607; Eddy Valve Co., Waterford, N. Y., $3,190.

OAKLAND, MD.—Bids are asked until Oct. 19 by the city for the construction of a water-works and sewerage system. Penniman & Fairley, 411 Marine Bank Bldg., Baltimore, are Engrs.

RICHMOND, VA.—See item under Light and Power Plants.

AUGUSTA, GA.—The city contemplates installing an auxiliary steam pump, to cost between $60,000 and $75,000.

TAMPA, FLA.—The Tampa Water-Works Co. will issue bonds for $1,000,000 for improving and extending the water-works system.

LUVERNE, ALA.—The city has voted bonds for construction of water-works and sewerage systems.

GULFPORT, MISS.—Bids were opened on Sept. 15 for constructing concrete reservoir. The contract was awarded to CHEVALLEY & FURSDON, of Gulfport, at $16,768. Other bidders were: Cook Construction Co., Des Moines, Iowa, $16,227; Graves-Matthews Paving Co., Birmingham, Ala., $17,087; West Construction Co., Chattanooga, Tenn., $18,-332; Southern-Ferro Concrete Co., Atlanta, Ga., $18,788; R. C. Huston, New Orleans, La., $29,329. M. F. Sullivan is City Engr.

CINCINNATI, OHIO.—We are officially advised that the only bid received by the Board of Public Service for cleaning water main, etc., was that of the National Water Main Cleaning Co., 27 William St., New York. The contract was not let, but will be readvertised in the spring of 1909.

*PITTSFIELD, ILL.—We are officially advised that bids were received on Sept. 17, by Williams & Williams, Pittsfield, for furnishing a 57,000-gallon per minute centrifugal pumping plant for the McGee Creek Levee & Drainage District. The plant will be located on the Illinois River about three miles below Meredosia, Ill. A. H. Beel is Engr.; E. R. Breaker is Mechanical Engr. The contract for furnishing the foundations, culvert and abutments and building was awarded to H. T. SPRAGUE, of Nauvoo, Ill. The contract for furnishing and installing the machinery, boilers, piping, etc., complete on foundations was awarded to the ARBUCKLE-RYAN CO., of Toledo, Ohio. The machinery comprised in this contract consists of two 32-in. volute type centrifugal pumps; two 16 × 20-in. Russel valve engines; two 72 × 18-in. return tubular boilers, all necessary heaters, feed pumps, etc. The culvert is to be a double 36-in. vitrified pipe culvert laid in concrete and furnished with valves and sluice gates so that it can be used for a natural drain as well as the suction and discharge from the pumps. The work is to be begun on this plant at once and is to be completed by Jan. 15, 1909.

RED OAK, IOWA.—Bids are asked until 7 p. m., Oct. 6, by the City Clerk, for the complete installation of a 45-HP. pumping plant of any of the various means of power.

SHAKOPEE, MINN.—Bids will be received until Oct. 5 by the Common Council, for furnishing material and constructing waterworks, consisting of c.-i. pipe and special castings, fire hydrant and valves, and a 100,-000-gallon steel tower and tank. A separate bid must be submitted for the tower and tank. Loweth & Wolff, of St. Paul, Minn., are Engrs. C. Theo. Weiland is City Recdr.

ST. MARYS, KAN.—The citizens on Aug. 11 voted to issue $47,000 bonds for the construction of water-works. Burns & McDonnell, Scarritt Bldg., Kansas City, Mo., are Engrs.

GREAT FALLS, MONT.—The Cottonwood Coal Co. will lay a water main from Wolf creek to Windham, the new coal town on the Billings & Northern Ry., a distance of 20 miles.

The city is contemplating the purchase of a new pump with a capacity of 2,500,000 gallons.

BROWNWOOD, TEX.—Bids are asked by the city until Oct. 15 for furnishing machinery for water-works pumping station, including single-acting belt-driven triplex power pump of 1,500,000 gallons capacity daily, and 100-HP. producer-gas engine to operate on Texas lignite.

*AUSTIN, TEX.—R. V. DIXON, of Austin, has been awarded the contract at $15,272 for constructing a reinforced-concrete pumping station. George L. Hume is Pres. Water, Light and Power Comn.

BURLINGTON, COLO.—Bids will be received until Oct. 12 by W. D. Seider, Chn. Water-Works Comn., for constructing waterworks, including elevated steel tank of 60,-000 gallons capacity, top of tank to be 100 ft. above the foundation; 5,6[illegible] lin. ft. 4 and 6-in. c.-i. pipe, a pump of [illegible] gallons per minute, hydrants, valves, [illegible] etc.

RATON, N. MEX.—The [illegible] Land & Irrigation Co., of Denver, [illegible] operating in Colfax County, N. Mex., [illegible] awarded the contract to COLE & [illegible] K, of Ft. Morgan, Colo., for the construction of reservoir No. 3 of its system, [illegible] for constructing an intake ditch 12 [illegible] long. The contract for the completion of [illegible] dam on reservoir No. 2 has already been let.

BELLINGHAM, WASH.—C[illegible] & CO., of Seattle, Wash., have been awarded the contract for supplying the [illegible] pipe for Sylvan St.

SAUSALITO, CAL.—The city [illegible] voted to issue $100,000 of bonds for the construction of water-works.

EDMONTON, ALTA.—The [illegible] rintendent of Water-Works has presented [illegible] report to the City Council providing for complete water-works and filtration system; cost approximately $250,000. The matter is now being considered by the City Council.

SEWERAGE.

(denotes that this work is advertised in Engineering News.)*

SPRINGFIELD, MASS.—The City Council on Sept. 14 passed an order providing for the issue of $160,000 bonds to provide for a building and a site for the Kensington Ave. School and for sewerage construction.

BRIDGEPORT, CONN.—The Sewer Commission recommended on Sept. 21 the construction of a double sewer system capable of carrying off the sewage of a city of 300,-000 population and emptying at two points, each 1½ miles into the Sound at a cost of $1,750,000. It is proposed to expend $350,-000 per year for five years.

BROOKLYN, N. Y.—Bids were opened on Sept. 16 by Bird S. Coler, Pres. Brooklyn Boro., for the following sewer construction, the bids being received on a percentage basis, the engineer's preliminary estimate of total cost to be taken as the 100% basis: (a) for furnishing material and constructing sewer in East 98th St., brick and concrete, from East New York Ave. to Hegeman Ave., with outlet sewers in East 98th St., etc., Sec. No. 1. Engineer's estimate of total cost, 60,077; (b) furnishing material and constructing brick and concrete sewer in East 98th St., from East New York Ave. to Hegeman Ave., with outlet sewers in East 98th St., etc., Sec. No. 2. Engineer's estimate, of total cost, $95,090; (c) furnishing material and constructing sewers in Scott Ave., from Newtown Creek, north of Metropolitan Ave., to St. Nicholas Ave., etc., Sec. 2. Engineer's estimate of total cost, $278,728. Bracken MacAveney Co., 44 Court St., Brooklyn, (a) 80%; (b) 78%; Douglas & Halen, Brooklyn, (a) 91%, (b) 90%; Siegretto & Mennino Co., (a) 76%, (b) 76%; Peace Bros., Flushing, L. I., (a) 94%, (b) 99%; Joseph Cavanaugh, 302 Lefferts Ave., Brooklyn, (a) 86%%; Charles A. Meyers, 1408 Union Ave., Brooklyn, (a) 86.97%; Donegan & Redmond Co., 5904 14th Ave., Brooklyn, (a) 86%, (b) 93%; O'Grady Bros., Brooklyn, (a) 94%, (b) 96%; Donion Construction Co., 84 Broadway, Brooklyn, (a) 84.7%; Culp & McCauley, Brooklyn, (a) 89.97%; J Keeley, Brooklyn, (a) 86.13%, (b) 92.13%; J. J. Creem Co., 688 Greene Ave., Brooklyn, (a) 76.75%, (b) 82.75%, (c) 69.75%; Murphy Bros., Bath Beach, (a) 83.8%; Gore Engineering & Construction Co., 206 Broadway, New York, (a) 104.8%, (b) 101.9%, (c) 95.2%; J. L. Carey Co., 100 Montague St., Brooklyn, (a) 75.48%; Bonacci & Vinoli Co., (b) 77.49%; C. A. Meyers, 1408 Union Ave., Brooklyn, (b) 88.97%; Ryan & Reilly, 26 South 15th St., Philadelphia, Pa., (b) 101.45%, (c) 77.70%; J. H. Gray & Co., 23d St. and Broadway, New York, (c) 78%%. H. Neumann, Scott Ave., Brooklyn, (c) 75%; Phoenix Construction Co., 41 Park Row, New York, (c) 80.9%.

TRENTON, N. J.—Bids will be received until Oct. 6 by Harry B. Salter, City Clk., for constructing a drain in a portion of Paul Ave.

PLAINFIELD, N. J.—Herring & Fuller, New York, have been selected to make preliminary surveys for the proposed trunk line sewer to include Plainfield, North Plainfield, Dunnellen, Bound Brook and East Bound Brook.

ALTOONA, PA.—Bids are asked by the Board of Public Works until 8 p. m., Oct. 2, for the construction of vitrified clay pipe sewers in various streets. J. B. Andrews is Chn. Bd.

FORT DU PONT (Delaware City post-office), DEL.—Bids will be received by the Constructing Q. M., U. S. A., until Oct. 23 for constructing a drain from boiler blow-off, connecting with ten buildings at this post.

OAKLAND, MD.—Bids will be received by the city for the construction of a sewerage system and water-works until Oct. 19. Penniman & Fairley, 411 Marine Bank Bldg., Baltimore, Md., are Engrs.

WASHINGTON, D. C.—Bids were received on Sept. 28 at the office of the Commissioners of the District of Columbia, for the construction of sewers: Warren F. Brenizer Co., Washington, D. C., $14,222; E. G. Grummel, Washington, $34,755. The contract has not yet been awarded, but the low bidder will probably receive it.

VICKSBURG, MISS.—Bids were opened by the Mayor and Board of Aldermen on Sept. 14 for furnishing materials and constructing complete a system of house sewers, approximating 30 miles of 8 to 27-in. pipe sewers with 400 manholes and 100 flush tanks, as follows: DUNN & LALLANDE BROS., Birmingham, Ala., $148,201 (awarded contract); Geisel Construction Co., St. Louis, Mo., $166,798; Nold Construction Co., Chattanooga, Tenn., $168,053; Irwin Bros., New Orleans, La., $183,692; William F. Hall, Clinton, Mo., $187,302; Guild & Co., Chattanooga, Tenn., $188,488; Boaler & Flynn, Chattanooga, Tenn., $197,229; Coone, Con-

struction Co., St. Louis, Mo., $202,127; M. O'Herron Co., New Orleans, La., $206,558; C. M. Bachalter, Birmingham, Ala., $219,-626; Shean & Long, Bessemer, Ala., $245,-456; William F. Mullins, St. Louis, Mo., $278,8[illegible] A. Gaboury & Sons, Jackson-ville, [illegible] $127,718 (not including tunnel). The [illegible] noted above do not include the pumping [illegible]station or the castings. Walter G. Kirkpatrick, of Jackson, Miss., is Engr.

DAYTON, OHIO.—WILLIAM HILT has been awarded the contract at $19,894 for constructing the Bolender Ave. sewer.

The J. BACKUS CONSTRUCTION CO. has been awarded the contract at $7,993, for constructing the Germantown St. storm sewer and [illegible]KER & DILL, at $3,028, for the Linwood St., sewer.

HAMILTON, OHIO.—Bids are asked until noon, Oct. 3, by the Board of Public Service for constructing sanitary sewers in certain streets. Charles Pabst is Secy. Bd.

JEFFERSON, OHIO.—Bids are asked until [illegible] m., Oct. 12, by P. C. Renick, County Auditor, for constructing 2,400 ft. of sewer and sewage disposal plant for county building. J. S. Matson is County Surv.

OAKLEY (Cincnnati post-office), OHIO.—Bids are asked until noon, Oct. 6, by Oscar Kessler, Village Clk., for labor and materials for constructing a sewer in a portion of Webster Ave., Clark St. and Madison Pike.

INDIANAPOLIS, IND.—Bids will soon be asked for by the Board of Public Works for the construction of the Brightwood sewer. Estimated cost, $175,000. J. T. Elliott is Chn. Bd.

WABASH, IND.—Bids are asked by Fremont M'Lees, City Clk., until 6 p. m., Oct. 12, for the completion of the work for the construction of a combined local sanitary and storm water sewer in the first alley north of Walter St., from the east gutter line of Miami St. to the center line of Cass St.

ELGIN, ILL.—We are officially advised that the contract for constructing the Sixth Ward sewer system has been awarded to LOGAN & GIERTZ, of Elgin, at $83,415. Other bidders were: Federal Improvement Co., Chicago, $96,600; James Healy, Chicago, $94,188; O'Shea & Shea, Hammond, Ind., $93,528; Green & Sons, Ottawa, $91,-482; E. R. Harding & Co., Racine, Wis., $89,978; Thomas D. Joy & Co., Chicago, $84,514; A. Thompson, Racine, Wis., $83,-973; Standard Construction Co., Chicago, $83,859; Robert Nelson, Racine, Wis., $82,-093; Dearborn & Jackson, Stone City and Cedar Rapids, Iowa, $82,900; Chicago Drainage Construction Co., Chicago, $81,186. Engineer's estimate, $97,554. Carl E. Plum is City Engr.

BLOOMINGTON, ILL.—Bids will be received until Oct. 1 by the city for the construction of 3,895 lin. ft. of 6, 12, 15 and 18-in. pipe sewer. C. F. Fauntz is City Engr.

•PEORIA, ILL.—We are officially advised that the contract for constructing the west section of the North Peoria sewer, bids opened Sept. 15, has been awarded to GREENE & SONS CO., of Chicago, at $219,-728. Other bidders were: E. R. Harding, Racine, Wis., $219,909; Dearborn & Jackson, of Cedar Rapids, Iowa, $244,088. Engineer's estimate, $221,308. Itemized bids are given under Contract Prices this week.

APPLETON, WIS.—Bids are asked until 4 p. m., Oct. 6 by E. L. Williams, City Clk., for constructing 1,000 ft. of 24-in. and 30-in. pipe sewer.

CARROLL, IOWA.—Bids will be received by J. A. Dougherty, City Clk., until 8 p. m., Oct. 5, for furnishing material and constructing 1,240 ft. 10-in. and 13,700 ft. 8-in. sewers and 4,930 ft. 6-in. subdrain.

ST. PAUL, MINN.—The Assembly on Sept. 17 voted to issue $75,000 bonds for the construction of the Aldine-Portland sewer. L. W. Rundlett is City Engr.

PIPESTONE, MINN.—Bids are asked until 8 p. m., Oct. 15, by the Common Council for the construction of sewers and appurtenances in sewer districts Nos. 11, 12 and 14. S. W. Funk is City Recdr.

ADAMS, MINN.—Bids are asked until Oct. 10, by F. Tolksdorf, Village Recdr., for constructing 1,600 ft. of pipe sewer.

PEABODY, KAN.—We are officially advised that plans for the construction of a sewer system here have been prepared by the W. K. Palmer Co., 718 Dwight Bldg., Kansas City, Mo., and it is expected that the work of construction will be begun soon.

HOLTON, KAN.—The W. K. Palmer Co., Kansas City, Mo., has prepared plans and specifications for the construction of a sewer system here.

HOLLY, COLO.—Plans for the construction of a sewer system here have been prepared by the W. K. Palmer Co., Kansas City, Mo.

TACOMA, WASH.—Bids have been received for work in sewer district No. 177 as follows: F. MARUCA, $4,502 (awarded contract); Antonio Farnno, $6,445; Galluci & Vasone, $5,641; Antonio Tagarelli, $6,217; Frank Ricco, $5,948; Swanson & Peterson, $6,710; Stole & Sweeney, $5,983; F. A. Kessall, $6,551; Lister Construction Co., $5,618; N. A. Jones, $6,283. Engineer's estimate, $7,226.

PORT TOWNSEND, WASH.—We are officially advised that bids will soon be asked by the city for the construction of a sewer system, nine miles in length. J. M. Hamilton is City Engr.

BERKELEY, CAL.—W. F. McClure, Town Engr., has prepared plans for storm sewer system for north part of city. Estimated cost, $86,381.

SAN FRANCISCO, CAL.—See item under Electric Railways.

SALT LAKE CITY, UTAH.—Bids are asked until 8 p. m., Oct. 9, by the Board of Public Works for constructing pipe sewers in sewer extension No. 190. H. C. McMillan is Secy. Bd.

FAIRBANKS, MORSE & CO., 218 South West Temple St., city, were awarded the contract on Sept. 17 by the Board of Public Works for installing a gas producing plant at the west side sewage pumping station at Ninth North and Seventh West Sts.

MONTREAL, QUE.—Bids are asked until noon, Oct. 2, by the City Clerk, for the construction of sewers in certain streets and sections of streets. John R. Barlow is City Surv.

GARBAGE DISPOSAL.

(• denotes that this work is advertised in Engineering News.)

•NEW YORK, N. Y.—Bids are asked by Foster Crowell, Comr. St. Cleaning, until noon, Oct. 13, for furnishing all the labor and materials for the final disposition of garbage.

BROOKLYN, N. Y.—The contract for removing the ashes of the city for a period of five years was awarded on Sept. 18 by the Board of Estimate to the BOROUGH CONSTRUCTION CO., and Charles Crawford, at 34½ cts. per yd.

INDIANAPOLIS, IND.—See item under Streets and Roads.

STREETS AND ROADS.

(• denotes that this work is advertised in Engineering News.)

MILFORD, N. Y.—The contract for constructing the State Road on South and East Main Sts., was let on Sept. 14, to GERHARDT & CO., of Brooklyn, at $6,483.

ALBANY, N. Y.—The following bids were received by the Board of Contract and Supply Sept. 21, for the improvement of Orange St., from Chapel St., to Lark St.: Edward F. Dillon, $39,290; Mulderry Bros., $35,727; John M. Holler, $33,675; Michael F. Dollard, $35,392; all of Albany. In this work 11,500 yds. of vitrified brick pavement on a rolled gravel foundation, were called for, for which Edward F. Dillon bid $2.15 per yd.; Mulderry Bros., $1.97 per yd.; Holler, $1.78; and Michael F. Dollard, $1.95.

The following bids were received by the board on the same day for paving Stanwix St., from Delaware Ave. to Second Ave.: Michael F. Dollard, $7,213; John M. Holler, $7,131; Mulderry Bros., $7,203.

For paving North Pearl St., for North First St., to North Second St., following bids were received: Michael F. Dollard, $7,821; John M. Holler, $8,429; Mulderry Bros., $7,766; Edward F. Dillon, $8,667. Isidore Wachsman is Secy. Bd.; Walter Mellus is City Engr.

NEW YORK, N. Y.—The following bids were opened on Sept. 17 by the Department of Bridges for regulating, grading and repaving Second Ave. and 59th St., Manhattan Borough, at the entrance to the Blackwell's Island Bridge, over the East River, between the Boroughs of Manhattan and Queens: CHARLES MEADS & CO., 299 Broadway, $14,300 (awarded contract); Thomas Tarpy, $15,402; Snare & Triest Co., $16,920; William Fickien & Co., $17,200; Atlantic Construction Co., $17,500; Bart Dunn, $17,074; Northeastern Construction Co., $24,-927, all of New York. J. W. Stevenson is Comr.

Bids were opened on Sept. 17 by the Park Board for paving and repaving with rock asphalt where directed, the walks of Central and other parks in the Borough of Manhattan. The lowest bid was that of the Sicilian Asphalt Paving Co., 41 Park Row, New York, at the following prices: 500 cu. yds. concrete furnished and deposited, $6.50; 125,000 sq. ft. pavement of rock asphalt mastic, 8¾ cts., and 200 lin. ft. 5-in. bluestone curb, $1.50. Total, $14,175. Other bidders were: Gormen & Lees, $21,550; the Neuchatel Asphalt Co., Ltd., $21,550.

NEW YORK, N. Y.—Bids are asked by Louis F. Haffen, Pres. Boro. of the Bronx, until 11 a. m., Oct. 15, for repaving with asphalt blocks and granite blocks on a concrete foundation various streets; for paving with asphat pavement or with mineral rubber pavement on a concrete foundation, the roadways and sidewalks of the bridges over the New York, New Haven & Hartford R. R. (Harlem River Branch) at Longwood Ave., Tiffany St., Hunt's Point Road, Faile St., Bryant St., Westchester Ave., Tremont Ave., West Farms Road, White Plains Road, Unionport Road, Williamsbridge Road and Baychester Ave.; and for furnishing and delivering broken trap rock stone and screenings.

•ROOSEVELT, N. J.—We are officially advised that the PLAINFIELD CEMENT STONE CO., Plainfield, was awarded the contract on Sept. 21 by the Mayor and Common Council for 30,000 sq. ft. concrete walks at 19¾ cts. per sq. ft.; 300 ft. concrete curb (radial), 90 cts. per ft.; and same at 20 cts. per sq. ft. and 75 cts. per ft. F. F. Simons, Carteret, N. J., is Engr.

•HAWORTH, N. J.—Bids are asked by the Borough Council for the grading, macadamizing and otherwise improving of Valley Road, Haworth Drive and a portion of Flatts Road, lying in the borough of Haworth, Bergen County, a distance of 16,527.06 ft., at the office of the Borough Clerk, at Haworth, N. J., until 8 p. m., Oct. 19. The plans, specifications, cross sections and blank form of bids are on file and may be examined between 9 a. m. and 5 p. m. at the offices of Watson G. Clark, Borough Engr., Tenafly, N. J., and 1123 Broadway, New York, or at the office of the Clerk of the Borough of Haworth, or at the office of the State Commissioner of Public Roads of the State of New Jersey, at his office in the State House, Trenton. E. A. Bell is Boro. Clk.

WEST HOBOKEN, N. J.—JOHN F. MURPHY was awarded the contract on Sept. 23 for paving Malone St., at $6.36. Other bidders were: August Thiel, $6,540; H. M. Schmidt, $7,432; Nolan & Hornung, $7,590.

SOMERVILLE, N. J.—The contract for the permanent improvement of East Main St. was awarded to WILLIAM HARDGROVE on Sept. 14 by the Board of Commissioners, at $11,000, for tarviated macadam.

STROUDSBURG, PA. — The HERRICK CONSTRUCTION CO., of Stroudsburg, was awarded the contract on Sept. 22, for constructing the stretch of State Road between the Bushkill Creek bridge, in Bushkill, to the Riverside Hotel property line, in Lehman Township, Pike County, 7,700 ft., at $11,959.

ETNA, PA.—Bids are asked until 5 p. m., Oct. 5, by A. R. Dunbar, Boro. Clk., for grading, paving and curbing a portion of Butler St.

GREENSBURG, PA.—RINEHART BROS., East Liverpool, Ohio, have been awarded the contract for constructing a State road in Ligonier Borough.

ERIE, PA.—Bids are asked until Oct. 5 by the Board of Public Works for paving portions of several streets. B. B. Briggs is City Engr.

DOYLESTOWN, PA.—T. P. SMART, Philadelphia, Pa., has been awarded the contract for constructing a State rod from Bristol Township.

NEW CASTLE, PA.—The NEW CASTLE CONTRACTING CO. has secured the contract at $7,250, for grading Scott St.

LOCK HAVEN, PA.—The E. M. GOOD CO., Lancaster, Pa., has been awarded the contract for constructing a State road in Lamar Township.

•CHARLESTON, W. VA.—Bids are asked by the Board of Affairs until 3 p. m., Oct. 9, for grading, curbing, paving and sewering certain portions of the streets and alleys in the city, the total amount of the work aggregating about $300,000. W. A. Hogue is City Engr.

ORANGEBURG, S. C.—The city proposes paving Russell St. with macadam. W. W. Hawes, City Engr., will prepare plans and specifications.

ALBANY, GA.—Dougherty County has decided to improve roads. The sum of $30,-000 is available, of which $5,000 will be expended for steam roller and other machinery and the remaining $25,000 for actual work.

CEDARTOWN, GA.—The City Council has appropriated $5,000 for the construction of cement sidewalks.

•ATLANTA, GA.—Plans and specifications are on file at the office of Engineering News, New York, for the construction of macadam roadways, about 20,000 to 25,000 sq. yds., on Ponce de Leon Ave., Druid Hills, Atlanta. Bids are asked until Oct. 3.

DECATUR, ALA.—M. CASEY & CO., Birmingham, Ala., have secured the contract for grading and surfacing 30 miles of road in Morgan County at about $100,000, contract involving erection of several trestles.

HUNTSVILLE, ALA.—The Madison County Commissioners have awarded the contract to JOHN A. CAMPER, of Huntsville, for rebuilding the Athens pike with gravel.

BESSEMER, ALA.—Bids will be received by the city until Oct. 6 for laying brick gutters on Second and Third Aves. E. B. Stuffs is City Clk.

ANNISTON, ALA.—The city contemplates the construction of 10,000 or 12,000 yds. of additional cement sidewalks before Jan. 1.

CHATTANOOGA, TENN.—The Noll Construction Co., 8 East Sixth St., Chattanooga, has submitted the lowest bid to the Board of Public Works at about $30,000 for paving roadway, vitrified brick, curbing and cement sidewalks on Bailey Ave., Oak and O'Neal Sts. H. F. Van Dusen is Chn. Bd.

The Park Commission has awarded the contract to E .P. NORRIS, Duncan Ave. and Spruce St., for rebuilding the roadway in Jackson Park, at about $5,000, involving tile drains 4,800 ft. long by 16 ft. wide.

LENOIR CITY, TENN.—The city has voted $10,000 of bonds for street improvements.

FORT THOMAS, KY.—Bids are asked until 10 a. m., Oct. 12, by John H Whalley, Constructing Q. M., U. S. A., for the construction of macadam roads and cement sidewalks.

YOUNGSTOWN, OHIO.—Bids are asked until noon, Oct. 2, by the Board of Public Service, W. H. McMillin, Clk., for paving West Boardman St.

DAYTON, OHIO.—Bids are asked until noon, Oct. 2, by W. A. Burdoe, Clk. Bd. Pub. Ser., for the improvement of Findlay St., the work including 2,565 lin. ft. of combined cement curb and gutter, 2,565 lin. ft. of grading and graveling sidewalks, 1,320 lin. ft. of grading and graveling roadway, 225 sq. ft. of street and gutter crossings, 160 lin. ft. of 15-in. pipe, and 60 lin. ft. of 12-in. pipe.

CLEVELAND, OHIO.—Bids are asked until 11 a. m., Oct. 14, by the County Commissioners, William F. Black, Clk., for grading, draining and improving Dunham Road from Bedford Road to Canal Road in Bedford and South Newburg Townships.

COLUMBUS, OHIO.—Bids will be received at the office of the Commissioners of Jefferson County, until noon, Oct. 6, for grading 2.11 miles, and macadamizing .78 miles of road in Cross Creek Township. Specifications, plans and profiles are on file in the office of the County Commissioners in Steubenville, Ohio, and at the State Highway Department. Copies of specifications may be obtained at the latter office. Estimated cost, $8,784. James C. Wonders is State Highway Comr.

FOSTORIA, OHIO.—Bids are asked until noon, Oct. 2, by the Township Clerk, London Township, Fostoria, for grading, constructing and furnishing all labor and material for a pike ½ mile long on Bull Frog Road.

INDIANAPOLIS, IND.—The Board of Public Works will soon ask for bids for grading and paving the roadway of 28th St., Christian St. and Gladstone Ave. with asphalt.

INDIANAPOLIS, IND.—Bids are asked by the Commissioners of Marion County until 10 a. m., Oct. 7, for furnishing crushed stone for road making and until Oct. 10 for furnishing one road grader.

MARTINSVILLE, IND.—Bids are asked by the Commissioners of Morgan County until 2 p. m., Oct. 6, for the construction of 13,426 ft. of gravel road in Brown Township and 13,250 ft. of gravel road in Bain Township. B. E. Thorburg is County Audr.

BLOOMFIELD, IND.—Bids are asked by the Commissioners of Green County until 2 p. m., Oct. 6, for the construction of a macadamized road in Fairplay Township. Peter M. Cook is County Audr.

HARTFORD CITY, IND.—Bids are asked by the Commissioners of Blackford County until 2 p .m., Oct. 6, for the construction of a gravel road in Jackson Township; length of the road, 13,884 ft. L. W. Daugherty is County Audr.

PORTLAND, IND.—Bids are asked by the Commissioners of Jay County until noon, Oct. 24, for the construction of a gravel road.

TERRE HAUTE, IND.—Bids are asked by the Commissioners of Vigo County until 11 a. m., Oct. 17, for the construction of the McClintock gravel road in Nevins Township. Nathan G. Wallace is County Audr.

MONTICELLO, IND.—Bids will be received by the Commissioners of White County until noon, Oct. 16, for the construction of a macadamized road in Prairie Township. J. L. Ackerman is County Audr.

WAUKEGAN, ILL.—The contract for paving with brick Marion St., bids opened Sept. 11, has been awarded to the McCUGO CONSTRUCTION CO., of Fond du Lac, Wis., by the Board of Local Improvements, at $53,966. F. W. Churchill is Secy. Bd.

LA CROSSE, WIS.—The contract for 7,394 sq. yds. macadam pavement, 4,796 ft. cement curb and gutter and 2,473 cu. yds. grading, bids opened Sept. 14, has been awarded by the Board of Public Works to the LA CROSSE STONE CO., La Crosse, at $9,550. A. J. Roberge is Secy. Bd.

ST. PAUL, MINN.—The Board of Public Works, R. L. Gorman, Clk., has awarded the contract for repaving with asphalt Sixth St., from Washington Ave. to Main Ave. to the BARBER ASPHALT CO., at $11,548.

LAWRENCE, KAN.—Bids are asked until 5 p. m., Oct. 5, by F. D. Brooks, City Clk., for furnishing materials and paving, grading and curbing various streets and alleys.

DALLAS, TEX.—The city has awarded the contract to the TEXAS BITULITHIC CO., of Dallas, at $2.55 per sq. yd. for paving Ross Ave. with bitulithic on a 5-in. gravel-concrete foundation.

The GENERAL SUPPLY & CONSTRUCTION CO., of Dallas, secured the contract at $2.25 per sq. yd. for paving Jackson St. with vitrified brick, with a 5-in. gravel-concrete base and asphalt filler.

SEATTLE, WASH.—The following contracts have been awarded by the Board of Public Works for the following local improvement work: 15th Ave. West and other streets, grading, etc., HOLT & JEFFERY, $36,000; Jones Ave. N. W., and other streets, grading, SEATTLE GRADING CO., $12,758; North 46th St. and other streets, grading, S. NORMILE, $19,614; Ninth Ave., N. W., and other streets, grading, same, $11,229; 19th Ave., N. W., and other streets, grading, H. D. MASTERSON, $3,880; Aurora Ave. and other streets, concrete walks, W. H. SMITH, $31,198; Fifth Ave. North, regrading, GRANT, SMITH & CO. & STILLWELL, $16,993; Eleventh Ave. North, and other streets, concrete walks, JOE FRANK, $13,894. R. H. Thomson is City Engr.

HILLYARD, WASH.—All bids for sidewalking Regal St. have been rejected and bids will again be asked. The lowest bid was that of John Weurch at $3,803, but no check accompanied the bid.

HOQUIAM, WASH.—The following bids have been received by the city for constructing sidewalks on Aberdeen and Simpson Aves.: D. P. Steepes, 34 cts.; C. M. Witzel and E. Jopple, 33 cts.; Ole Lender, 24½ cts.; MAT STROMMER, 31 cts. (awarded contract); Emil West, 33 cts.

EVERETT, WASH.—THORSVIG & MILEY have been awarded the contract for the improvement of Colby Ave. to the north line of Division B, by the Board of Public Works. The bids follow: Thorsvig & Miley, $9,324; L. C. Hall & Co., $9,724; Ellenson & Thorsvig, $9,546. The estimate of the City Engineer was $10,769.

OLYMPIA, WASH.—Bids will be received until Oct. 2 by the Secretary of the State Highway Board for grading and cribbing State aid road No. 28 in Mason County; also for grading, etc., State aid road No. 26, in Cowlitz County, and State aid road No. 31, in Chelan County.

MT. VERNON, WASH.—The contract for the construction of State aid road No. 24, or what is known as the Burlington, Sedro-Woolley and Bellingham highway, has been awarded to W. T. STEVENS, of Mt. Vernon, at $4,200.

SEATTLE, WASH.—GEORGE W. WALKER, Seattle, Wash., has been awarded the contract by the city for the improvement of Plum St. and other streets, at $45,884. Other bidders were: International Contract Co., 738 New York Block, Seattle, $56,282; Krogh & Jessen, Seattle, $50,684. R. H. Thomson is City Engr.

SAN FRANCISCO, CAL.—See item under Electric Railways.

SACRAMENTO, CAL.—The Board of Supervisors on Sept. 14 opened bids as follows, for macadamizing the Lower Stockton Road: (a) Section 1, (b) Section (2) and (c) Section 3: Clarke & Henery (a) $26,320, (b) $29,-244, (c) $39,088J. S. Buggess (a) $25,382; W. F. Hanrahan (a) $27,514, (b) $30,396, (c) $40,033; MacDonald & Hayes (c) $35,720; John Walthar, (c) $24,001.

RIVERSIDE, CAL.—The McINTYRE CEMENT CO. has secured the contract for improving a portion of Mulberry St., at $12,044.

VANCOUVER, B. C.—The Council has authorized that the contract for block-paving Homer St., from Pender to Georgia Sts., be awarded to COTTON & CAMPBELL, and similar work on Richards St. to CHRISTIAN & HARTNEY.

MANUFACTURING PLANTS.

(denotes that this work is advertised in Engineering News.)*

AUBURN, ME.—We are advised by Miller & Mayo, Archs., Lewiston, Me., that the general contract for constructing a 4-story brick shoe factory, 50 × 180 ft., for the Lunn & Sweet Shoe Co., Auburn, has been let to J. A. GREENLEAF & SON.

WINDSOR LOCKS, CONN.—The contract for the construction of a factory, 50 × 50 ft., two stories high, of brick with concrete base, has been awarded by the Medlicott Co. to WATSON TYRON & SON, 720 Main St., Hartford, Conn.

NEW BRITAIN, CONN.—The Hart & Cooley Co., Booth St., will erect a 3-story addition, 50 × 50 ft., to its factory building, which will provide 7,800 sq. ft. of floor space. M. J. Unkiebach, 162 Main St., is Engr.

NEW YORK, N. Y.—A. V. Porter, 62 Broadway, and J. R. Spelman, Archs., for Adrian Joline and Douglas Robinson, Receivers of the Metropolitan Street Ry. Co., filed plans for the proposed car barn. The building will be of brick and ornamental stone, with a frontage of 135.10 ft. and a depth of 298.10 ft. in 54th St. It will be five stories high in the main part and three stories in the annex, and will cost completed about $450,000. The architects state in their application for a permit that it is the intention to build two stories at once, and that this will cost about $300,000. The building will be fireproof and will have elevator service.

HUDSON, N. Y.—We are officially advised that the AMERICAN CEMENT ENGINEERING CO., 315 Fifth Ave., New York, has secured contract to construct for the Knickerbocker Portland Cement Co. two cement plants on the Hudson River with a combined daily capacity of 12,000 bbls. and an annual output of not less than 4,000,000 bbls. of Portland cement. Work will start immediately on rebuilding the 2,000-bbl. plant at Hudson, on the east bank of the river. Its daily capacity will be raised to 6,000 bbls. The engineering company agrees to have the plant ready to reach a production at the rate of 2,000,000 bbls annually late next spring.

The plant on the west bank, near Catskill, will have construction started early next year, and will be completed and in operation about a year from the date the foundations are started. Both contracts provide for machinery and factory construction generally.

PORT JEFFERSON, N. Y.—We are officially advised that Frederick L. Smith, Industrial Engr., 5 Beekman St., New York, is engaged on plans for a brick plant for the Dyett Sand-Lime Brick Co., 103 Park Ave., New York. It will have a daily output of 100,000 brick. The equipment will consist of brick-making machinery, curing cylinders, power plant, piping, belting, shafting, industrial railway, etc. The buildings will be of structural steel and corrugated iron, concrete and timber. There will be six buildings and the cost of equipment will be $50,000.

CALEDONIA, N. Y.—The Marengo Portland Cement Co., E. J. Davis Supt., Caledonia, will soon start construction on a stone crusher plant to be erected at a point on the Erie R. R. tracks between Caledonia and Stafford.

BUFFALO, N. Y.—Wm. Holland & Sons, varnish manufacturers, are having plans prepared for a branch plant to be built in this city on a site just purchased at the foot of Church St. on the Erie Canal and the New York Central R. R. The plant will comprise four buildings, two of which will be built this fall.

YONKERS, N. Y.—The Otis Elevator Co., Chicago St. and Lehigh Valley R. R., Buffalo, N. Y., is having plans prepared for a branch factory, which it will build at Yonkers. The building will be of brick and steel construction, one story in height, 75 × 200 ft., 50 ft. high, to be used for foundry purposes. Bids will be called for by the company as soon as the plans are completed.

PITTSBURG, PA.—The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburg, will let contracts soon for a complete foundry to cost about $100,000 with equipment, as an addition to the New Brighton plant. The building will be of reinforced-concrete construction throughout, including roof, and will have a cellar for sand-handling machinery, storage, etc. Machine molding will be practiced exclusively. Francis J. Torrance is Vice-Pres.; W. A. Myler, Secy.-Treas.

ERIE, PA.—We are officially advised that the general contract for construction of a fireproof steel and brick machine shop, 100 × 125 ft., has been let to the HENRY SHENK CO., and the steel contract to the PITTSBURG STEEL CONSTRUCTION CO., Lewis Bldg., Pittsburg. The Osborn Engineering Co., Osborn Bldg., Cleveland, Ohio, Engrs.

BALTIMORE, MD.—L. M. Rancke, Vice-Pres. and Gen. Mgr., Baltimore Retort & Fire Brick Co., Hull and Nicholson Sts., Baltimore, has awarded contract to J. J. WALSH & SON, 1525 Maryland Ave., Baltimore, for construction of four fireproof buildings. There will be a 1-story building, 50 × 142 ft., a 2-story building 80 × 142 ft., a 2-story brick office building, 20 × 28 ft. and a steel shed, 145 × 88 ft.

MARION, N. C.—The Mt. Ida Hosiery Mills Co., which was incorporated at Marion, N. C., recently, has organized and decided on plans for the plant. R. L. Greenlee has been elected Secretary and Treasurer, and he is in charge of building and equipping the mill. A building will be erected about 110 × 40 ft., to be equipped with 50 knitting machines and accompanying apparatus. The power will be generated by a 50-HP. boiler and engine. This company is capitalized at $25,000.

WINNFIELD, LA.—The Chicago, Rock Island & Pacific Ry. Co. is having plans prepared by A. T. Hawk, Arch., 806 La Salle St. Station, Chicago, Ill., for terminals at Winnfield, to cost $40,000. Work will consist of a 9-stall frame round-house, a 60-ft. steel turntable, a 130-ft. cinder pit, a 50,000-gallon frame water tank and 40-ft., 100-ton scales. The contract for the work has been let to GEORGE B. SWIFT & CO., 188 East Madison St., Chicago.

NORWALK, OHIO.—B. A. Worthington, Receiver for the Wheeling & Lake Erie R. R. Co., Perry-Payne Bldg., Cleveland, Ohio, advises us that it is intended to rebuild the Norwalk locomotive shops which were destroyed by fire about a month ago.

AKRON, OHIO.—We are advised by the Osborn Engineering Co., Osborn Bldg., Cleveland, Ohio, that the following contracts have been let for the construction of a 5-story fireproof steel, concrete and brick calender plant, 60 × 220 ft., for the B. F. Goodrich Co., Akron; General contract to the NATIONAL CONCRETE FIREPROOFING CO., 2561 East 89th St., Cleveland; steel, to the NATIONAL IRON & WIRE CO., 3901 Hamilton St., Cleveland, Ohio.

NORWOOD (Cincinnati post-office), OHIO.—The Pfau Mfg. Co., of Hunt St., will build a $100,000 plant at the corner of Mentor and Hustin Aves., Norwood. The plant is to consist of a brick factory, the principal building being four stories, 340 ft. long by 50 ft. deep. It will contain 75,000 sq. ft. of floor space. In the rear of this will be a power house and electric plant, a brass foundry of 50 × 75 ft., boiler and engine building of 50 × 60 ft. and six dry kilns, the total dimensions of which will be 27 × 110 ft. The latter will be constructed of concrete. Harry Hake, Union Trust Bldg., Cincinnati, is Arch.

BLOOMINGTON, IND.—The Indiana Creosoting Co. has ordered plans for the construction of an addition to the present plant. Estimated cost, $25,000. Bids will be in order soon. Joseph H. Durham is Mgr.

HAMMOND, IND.—The Chicago, Cincinnati & Louisville R. R. Co. has purchased ten acres of ground at Hammond, on which it will build its division terminal machine shops and roundhouse. The shops are now located at Peru. R. P. Dalton is Gen. Supt.

DAVENPORT, IOWA.—The Bettendorf Steel Car Works, of Bettendorf, it is reported, will erect an addition to their works, expending about $350,000 in the improvements. A new foundry will probably be erected.

KANSAS CITY, MO.—The Blue Island Car & Equipment Co., whose freight car building and repair plant is in the Pullman District of Chicago, is coming to Kansas City to build a large plant. Representatives of the company have purchased 16 acres of land at Twelfth St. and Eastern Ave., in the suburbs, for $30,000. Two buildings will be erected this fall at a cost of $300,000. The company intends to begin the manufacture of freight cars before winter begins.

EL DORADO, ARK.—The Chicago, Rock Island & Pacific Ry. Co. will erect a terminal at El Dorado, to cost $40,000. An 11-stall frame roundhouse, a 64-ft. steel turntable, a 130-ft. circular pit, a 115,000-gallon steel stand pipe and a 40-ft. 100-ton track scales will be constructed. The contract has been let to GEORGE B. SWIFT & CO., 188 East Madison St., Chicago.

BURLINGTON, WASH.—A corporation has been organized composed of J. A. Peth of Laconner Flats, P. M. Moody and R. F. Dunlap, of Burlington, to be known as the Skagit Talc Co. for the purpose of mining and manufacturing the talc from the mine now opened on Burlington Heights. Machinery will be ordered at once for a large plant, which will be erected at the foot of the heights.

BRIDGEBURG, ONT.—Pratt & Lambert, varnish manufacturers, 79 Tonawanda St., Buffalo, N. Y., will establish a branch factory at Bridgeburg on the Niagara River opposite Buffalo at the International Bridge. Buildings to cost $25,000 and will be erected at once.

OTTAWA, ONT.—We are advised by James D. Fraser, Secy.-Treas., Ottawa Electric Ry. Co., that the contract for constructing car barns on Coburg St. has been awarded to HOLBROOK & SUTHERLAND, of Ottawa. The building will be fireproof, one story high, 66 × 325 ft., and will cost $35,000. J. Albert Ewart, Sparks Chambers, Ottawa, is Arch.

WINNIPEG, MAN.—Bids are asked until noon, Oct. 8, by P. E. Ryan, Secy. Comrs. Trans-Continental Ry., Ottawa, Ont., for the filling required in connection with the preparation of site for shops on the Trans-Continental Ry., about six miles east of Winnipeg. Hugh D. Lumsden, Ch. Engr., Ottawa, Ont., and S. R. Poulin, Dist. Engr., Winnipeg, Man.

MISCELLANEOUS CONTRACTS.

(denotes that this work is advertised in Engineering News.)*

U. S. RECLAMATION SERVICE.—All news relative to canal projects, etc., will be found under Water Supply—Irrigation.

FILLING.—Winnipeg, Man.—See under Manufacturing Plants.

DITCH.—Elbow Lake, Minn.—Bids will be received until Oct. 10 by O. E. Wold, County Audr., for constructing Ditch No. 8.

RAILWAY CONSTRUCTION.—See "Carolina, Clinchfield & Ohio R. R.," "Georgia," and "Canada," under Railways, in this issue.

CEMENT.—New York, N. Y.—Bids are asked by Allen N. Spooner, Comr. of Docks, New York, until noon, Oct. 8, for furnishing and delivering cement.

DITCH.—Flandreau, S. Dak.—Bids will be received until Oct. 6 by Asa Loucks, County Audr., Flandreau, for constructing the Peerless drainage ditch.

DITCH.—Oregon, Wis.—Bids will be received until Oct. 8 by George Hartlein, Secy. Bd. Comrs. of Badfish Drainage District, for main ditch, laterals and tile work.

DITCH.—St. Paul, Minn.—The State will contribute $15,000 and the services of the State Engineer, to help construct the cut-off ditch projected in Aitkin County.

LIGHTHOUSE.—Estevan, B. C.—The Department of Marine and Fisheries, Ottawa, Ont., has decided to erect a lighthouse here 100 ft. high, of reinforced concrete.

LEVEE.—Vicksburg, Miss.—Bids will be received until Oct. 14 by Capt. Clarke S. Smith, Corps Engrs., U. S. A., Vicksburg, for about 78,000 cu. yds. of levee work.

DITCH.—Minneapolis, Minn.—Bids will be received until Oct. 5 by Hugh R. Scott, County Audr., Minneapolis, for digging and constructing Ditch No. 13. Estimated cost, $23,049.

DITCH.—Utica, Neb.—The contract for constructing a tile ditch, bids opened on Sept. 18, has been awarded to JOHN G. MATT, of Grand Island, Neb., at $10,950. C. G. Hurlburt is Secy.

REPAIRING BOAT.—Baltimore, Md.—Bids are asked by the Board of Awards until 11 a. m., Oct. 7, for furnishing labor and materials for repairs to the ice-boat Latrobe. Oscar F. Lackey is Harbor Engr.

TILE DRAIN.—Webster City, Iowa.—M. L. HENDERSON, Randall, Iowa, has been awarded the contract for the construction of a tile drain in Hamilton County. R. G. Austin is Designing Engr., Webster City.

LEVEE.—Shreveport, La.—The Caddo Levee Board, on Sept. 18 awarded the contract to MIKE M. HUNT, at 16.16⅔ cts. per cu. yd. for the construction of the Riverdale levee at Lucas Station. Total cost, about $20,000.

DERRICKS.—Brooklyn, N. Y.—The G. & W. MFG. CO., 26 Cortlandt St., New York, has been awarded the contract for furnishing the Bureau of Sewers, Borough of Brooklyn, with six experimental steel traveling derricks.

LANTERN.—New London, Conn.—Bids are asked until 1 p. m., Oct. 22, by the Lighthouse Engineer, Tompkinsville, N. Y., for furnishing one fourth order lantern for Southwest Ledge Light Station, New London Harbor, Conn.

BULKHEAD.—San Francisco, Cal.—The Harbor Commissioners on Sept. 17 awarded to the PACIFIC CONSTRUCTION CO., 16 California St., San Francisco, Cal., the contract for building a steel and concrete bulkhead on Section 12 of the seawall. The work will cost $64,500.

DAM.—Dayton, Ohio.—Bids are asked until Oct. 2 by the city for the construction of the Riverdale dam, northern part of city. Bids for this work were to be received on Sept. 12, but no bids were submitted. William A. Budros is Clk. Bd. Pub Ser.

DITCH.—Salem, Neb.—Bids were opened on Sept. 18 by R. E. Grimstead, of Salem, Drainage Comr. Richardson County, for constructing a ditch 18 miles long in Nemaha Valley. The contract was awarded to TURNER, MORGAN & CO., of Bellefontaine, Ohio, at $205,108.

WIRELESS STATIONS.—Victoria, B. C.—The Dominion Government has decided to erect six more wireless telegraph stations along the Pacific coast and may possibly erect an additional three. Col. Anderson, Ch. Engr. Marine and Fisheries Dept., Ottawa, Ont.

WHARF AND DOCK.—Welland, Ont.—The Canadian Government has awarded to JOSEPH BATTLE, Thorold, Ont., the contract for the construction of a wharf and ore dock on the Welland Canal here at $50,000. The dock will be for the use of the Ontario Iron & Steel Co.

COAL-HANDLING EQUIPMENT.—Buffalo, N. Y.—The Steel Cable Engineering Co., Boston, Mass., submitted the lowest bid on Sept. 24 for a coal and ash-handling equipment in the north boiler house at the pumping station, Bureau of Water. Francis G. Ward is Comr. Pub. Wks.

DRAINAGE DITCH.—Paxton, Ill.—The Commissioners of Sugar Creek Drainage District, at Paxton, Ford County, on Sept. 18 awarded to G. A. McWILLIAMS, of Walnut, Ill., the contract for the construction of eight miles of drainage ditch, 160,000 yds. of excavation, at 9.74 cts. per cu. yd.

SMOKE CONSUMING DEVICE.—Dayton, Ohio.—Bids will be received until Oct. 8 by the Board of Trustees of the County Memorial Building, J. C. Reber, Chn., at the office of W. E. Russ, Arch., 1300 Conover Bldg., Dayton, for a smoke consuming device for the Memorial Building, Dayton.

BUILDING BOAT.—Detroit, Mich.—The contract for constructing a boat for the Detroit-Port Huron route of the White Star Line, Detroit, has been awarded by the company to the TOLEDO SHIPBUILDING CO., Toledo, Ohio. The boat will cost about $125,000. B. W. Parker is Gen. Mgr.

FIRE-ENGINE, ETC.—Vancouver, B. C.—Bids will be received until noon, Oct. 15, by W. McQueen, City Clk., for the supply of an automobile chemical fire-engine and also an automobile hose truck, delivery by Jan. 1, 1909. Specifications may be obtained from the Chief of the Fire Department.

VACUUM CLEANING SYSTEM.—Rochester, N. Y.—The following bids were opened on Sept. 18 at the office of the Supervising Architect, Treasury Department, Washington, D. C., for the installation of a vacuum cleaning system for the U. S. [illegible]-office and Court-house here: Gem Co[illegible]ssed Air & Vacuum Co. St. Louis, Mo., $2[illegible]; Brandell-Mack Co., Bradford, Pa., [illegible]; Spencer Turbine Cleaning Co., Hartf[illegible] Conn., $2,992.

REPAIRING SEAWALL.—[illegible] York, N. Y.—M. A. RYAN, 48-50 Hal[illegible] York, N. Borough of Queens, has been [illegible] Astoria, contract by the Department [illegible]arded the ties for raising, straightenin[illegible]d repair-ing seawall, City Hospita[illegible] Island, Island, New York, at $3.7[illegible] Blackwell's opened on Sept. 22. Bids were

CONCRETE FENCE.—Lon[illegible]land City (L. I.), N. Y.—We are officiall[illegible]vised that the TURNER CONSTRUCTI[illegible] CO., 11 Broadway, New York, has bee[illegible]arded the contract by the Long Island [illegible] Co. for the construction of 1,800 ft. [illegible]reinforced concrete fence in connection [illegible] the At-lantic Avenue freight yards, [illegible]ong Island City.

WALL.—Oakland, Cal.—Bids [illegible] received as follows on Sept. 16 by the [illegible] of Pub-lic Works, W. B. Fawcett Se[illegible] for the construction of rip-rap wall al[illegible] the west-ern site of the channel between [illegible] Eighth St. bridge and the 12th St. [illegible] Waldie & Co., Berkeley, Cal., $1.56 [illegible] cu. yd.; Piedmont Paving Co., Oakland, [illegible] per cu. yd. F. C. Turner is City Engr.

HEADSTONES.—New York, N. Y.—The contract for furnishing and erecting 100 headstones over the graves of the marines, as provided by law, in the several cemeteries situated in the counties of Kings and Queens, has been awarded by Rear Adm. S. Coler, Pres. Boro. Brooklyn, to PATRICK M. HARAN, Tilden Ave. Bank Bldg., Brooklyn, at $11.38 each. Bids were opened on Sept. 22.

WHARF AND DREDGING.—Norfolk, Va.—Bids are asked until 11 a. m., Oct. 17, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for a timber wharf about 350 by 50 ft., and dredging about 40,000 cu. yds. of mud, etc., at the navy yard, Norfolk. Specifications are on file at the office of Engineering News, New York. William M. Smith is Acting Ch. Bureau.

LEVEE.—New Orleans, La.—The following are the bids opened on Sept. 18 by the Mississippi River Commission, Fourth District, 1539 Louisiana Ave., for 167,000 cu. yds. earthwork in Pontchartrain levee district: Babbitt & Linnan, Baton Rouge, 22.60 cts. per cu. yd.; Robert A. Clark & Co., Natchez, Miss., 20.9 cts.; Helgason Bros., Vicksburg, Miss., 23.5 and 24.5 cts. The bid of Robert A Clark & Co. has been recommended for acceptance.

LEVEES.—New Orleans, La.—Contracts have been awarded by the State Board of Engineers for the construction of a number of levees along the Mississippi River, as follows: Concord levee, new, 35,000 cu. yds., 28.50 cts. per cu. yd. to GEORGE H. CONRAD; Oak Point levee, new, 28,000 cu. yds., GEORGE H. CONRAD, 27 cts. per cu. yd.; Riceland to Home Place levee, enlargement and revetment, earthwork, 30,000 cu. yds., revetment, 10,000 ft., PATRICK LYONS, revetment, $1 per ft., earthwork, 24.48 per cu. yd.; Pinaud levee, new, 10,000 cu. yds., S. M. FUCISH, JR., 17.20 cts. per cu. yd.; Cannon to Nestor levee, enlargement and revetment, earthwork 15,000 cu. yds., revetment, 7,000 ft., S. M. FUCISH, JR., revetment, 79 cts. per ft., earthwork, 23½ cts. per cu. yd. Noted last week.

FILE CASES.—New York, N. Y.—Bids were received as follows on Sept. 18 by John F. Ahearn, Pres. Boro. of Manhattan, for furnishing and erecting steel file cases in the offices of the Clerk of the County of New York, on the eighth floor in the Hall of Records Building, Borough of Manhattan, City of New York, and for other furnishings required for said office; with the repairs and alterations, and the materials and labor required for alterations; also for extension to the electric lighting equipment, and for carpenter and cabinet work, hardware, metallic and other furniture, electric light work, lighting fixtures, marble and bronze work, painting, plastering and other work required to be done in connection with, and for the purpose of furnishing and erecting such steel file cases and such other furnishings required for said office: A. W. Gray & Co., 237 West 57th St., $118,700; Geo. W. Cobb, Jr., 148 Nassau St., $105,386; Van Dorn Iron Works, Cleveland, Ohio, $141,997; Neptune B. Smythe, 1123 Broadway, (withdrawn); Remington-Sherman Co., 359 Broadway, $129,000.

Readers' Wants

If you are in the market for material, equipment or supplies, and fail to find it in our advertising pages, send us full particulars, and we will gladly put you in touch with the right parties.

COAL CARS.—Philadelphia, Pa.—A. V. Kaiser & Co., Drexel Bldg., Philadelphia, write us that they are in the market to purchase 200, 50-ton capacity, second-hand hopper bottom steel coal cars, for immediate delivery.

TRACK TOOLS, ETC.—Ste. Flavie Station, Que.—R. E. Hunter, Ch. Engr. and Supt. of Constr., Matane & Gaspe Ry. Co., Ste. Flavie Station, Que., writes us that he desires catalogs and prices of track tools, concrete mixers, rock crushers and aerial cableways.

TRACK EQUIPMENT, ETC.—Covington, La.—Preston Herndon, Consult. Engr., Covington, La., writes us that he is in the market for track equipment, supplies, tools, etc., and desires to be furnished with data, catalogs, prices, etc.

CONTRACT PRICES.

[Where • precedes item under Contract Prices the work was advertised in Engineering News.)
(* denotes that this work is advertised in Engineering News.)

*RESERVOIR.—Stamford, Conn.—Bids were received as follows on Sept. 10 by the Stamford Water Co., 125 Atlantic St., Stamford, for the construction of a dam, together with other works necessary to the enlargement of the Mill River reservoir: Albert B. Hill, New Haven, Conn., Consult. Engr.: (A) A. B. GRISWOLD, New Britain, Conn. (awarded contract); (B) Godwin Construction Co., 30 Church St., New York; (C) E. G. Bangs, New York; (D) R. K. Everitt & Co., Tarrytown, N. Y.; (E) Boston & New York Contracting Co., 220 Devonshire St., Boston, Mass.; (F) New York Continental Jewell Filtration Co., 15 Broad St., New York; (G) Bunting, Bull Co., Lever Bldg., Flushing, N. Y.; (H) C. W. Blakeslee & Sons, New Haven, Conn.; (I) O'Brien Construction Co., Waterbury, Conn.; (J) R. W. Sherman, Utica, N. Y.; (K) Arthur McMullen, Stamford, Conn.; (L) John O. Merritt Co., Portchester, N. Y.; (M) J. B. Malatesta, 3169 Jerome Ave., New York; (N) R. E. Boggs, Charlottesville, Va.; (O) Richards & Gaston, 143 Liberty St., New York; (P) Tucker & Vinton, 103 Park Ave., New York; (Q) Coleman Bros., 15 Court St., Boston, Mass.; (R) Russell Contracting Co., 156 Fifth Ave., New York; (S) United Engineering & Contracting Co., 32 East 33d St., New York; (T) F. Wardwell, Stamford; (U) Decicco Contracting Co., Larchmont, N. Y.; (V) Engineer's estimate:

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
8,000 cu. yds. earth excavation, dam and bridge	$0.60	$1.00	$0.90	$0.80	$0.65	$0.85	$1.15	$0.70	$0.35	$1.30	$0.75
30,000 cu. yds. earth excavation, highway	.36	.50	.90	.31	.40	.35	.48	.38	.30	.40	.32
10,000 cu. yds. rolled earth embankment	.78	.40	.15	.25	.40	.40	.49	.60	.50	.50	.55
1,000 cu. yds. rock excavation, dam and bridge	2.85	3.00	3.00	3.00	3.00	2.75	3.50	2.00	2.00	3.60	1.50
300 cu. yds. rock excavation, highway	2.35	2.50	3.00	1.45	4.00	2.00	2.00	1.40	1.25	1.50	2.00
12,000 cu. yds. concrete, dam and appurtenances	2.55	3.21	3.00	3.75	3.90	3.95	3.32	4.36	4.50	3.85	4.50
500 cu. yds. concrete, bridge abutments and wings	3.85	5.00	3.00	5.00	3.90	4.70	6.00	4.50	4.50	5.25	5.00
400 cu. yds. concrete, arch rings, parapets	6.35	6.00	3.00	5.55	6.00	5.90	6.00	5.25	5.25	5.25	5.50
1,000 cu. yds. cement rubble	2.25	2.00	3.00	3.50	3.75	4.00	2.50	4.25	4.50	5.25	3.75
200 cu. yds. dry rubble	1.50	2.00	3.00	3.00	3.75	3.50	2.50	4.00	3.50	....	2.00
1,800 sq. yds. riprap	.56	.75	1.50	.98	1.00	1.00	1.00	1.00	1.50	1.50	.40
15,000 bbls. Portland cement	1.91	1.50	1.50	1.65	1.70	1.75	2.00	1.52½	1.70	1.65	2.00
500 bbls. hydrated lime	2.21	2.50	1.70	2.00	2.00	1.40	2.20	1.58	2.10	2.00	1.75
50,000 lbs. reinforcing steel	.04	.03	.03	.02¾	.04	.033	.03	.04¼	.05	.04½	.04
100 lin. ft. vitrified pipe culvert, 18"	1.80	1.00	1.10	1.00	1.50	1.00	1.50	1.45	2.00	1.20	1.25
100 lin. ft. vitrified pipe culvert, 12"	1.56	1.00	.75	.60	1.50	.75	1.50	1.50	1.50	.75	1.00
12,000 lin. ft. wire fencing	.15	.10	.12	.55	.10	.11	.16	.21½	.18	.20	.23
3,000 lin. ft. timber railing	.24	.25	.12	.15	.20	.25	.25	.18	.20	.25	.12
350 lin. ft. iron railing	.72	.50	.15	.40	1.00	1.00	1.50	2.25	.50	.50	.50
15 mere stones	3.60	4.00	3.00	4.00	3.00	5.00	3.00	2.00	4.00	5.00	3.00
Total amount of bid	$103,045	$108,765	$114,532	$115,504	$117,745	$118,480	$122,100	$123,322	$122,320	$125,770	$127,710

	(L)	(M)	(N)	(O)	(P)	(Q)	(R)	(S)	(T)	(U)	(V)
8,000 cu. yds. earth excavation, dam and bridge	$1.40	$1.25	$0.32	$1.00	$0.51	$0.75	$1.16	$1.08	$0.60	$0.60	$0.80
30,000 cu. yds. earth excavation, highway	.39	.40	.33	.45	.57	.40	.42	.50	.43	.40	.35
10,000 cu. yds. rolled earth embankment	.58	.65	.55	.75	.44½	.50	.61	.65	.53	1.25	.70
1,000 cu. yds. rock excavation, dam and bridge	4.00	4.00	1.53	3.00	3.81	5.00	2.50	3.85	3.50	4.50	2.50
300 cu. yds. rock excavation, highway	1.50	2.00	.80	2.00	3.17	3.00	1.50	2.70	1.50	1.50	1.25
12,000 cu. yds. concrete, dam and appurtenances	3.94	4.00	4.95	4.50	4.58	5.10	5.00	4.05	5.50	5.50	4.00
500 cu. yds. concrete, bridge abutments and wings	5.20	5.50	5.70	4.50	5.00	7.00	7.35	6.25	5.50	7.50	5.00
400 cu. yds. concrete, arch rings, parapets	5.20	7.50	5.70	7.00	6.35	9.00	10.93	6.60	10.00	10.00	6.00
1,000 cu. yds. cement rubble	4.00	3.50	8.25	5.50	3.17	6.00	3.53	5.30	5.00	7.50	4.50
200 cu. yds. dry rubble	2.50	1.50	3.60	5.00	2.54	5.00	2.51	5.00	4.00	7.00	4.00
1,800 sq. yds. riprap	.90	2.00	1.04	1.50	1.08	1.00	1.83	3.40	1.50	2.50	1.00
15,000 bbls. Portland cement	1.79	1.50	1.65	1.60	2.28	1.75	1.92	2.40	2.00	2.10	1.60
500 bbls. hydrated lime	2.70	3.50	2.00	1.60	1.46	1.30	2.00	2.00	2.30	2.10	1.00
50,000 lbs. reinforcing steel	.02¼	.03¾	.05	.04	.03	.04	.04	.04½	.04¼	.05	.03
100 lin. ft. vitrified pipe culvert, 18"	1.08	2.00	1.50	.80	1.27	2.25	1.10	1.00	1.05	1.50	1.25
100 lin. ft. vitrified pipe culvert, 12"	.77	1.50	1.00	.50	.95	1.50	.85	.95	.90	1.10	.80
12,000 lin. ft. wire fencing	.30	.30	.20	.15	.13	.18	.23	.30	.39	.35	.15
3,000 lin. ft. timber railing	.20	.60	.15	.15	.13	.15	.20	.35	.29	.29	.12
350 lin. ft. iron railing	.75	2.00	.40	.50	.32	.40	1.00	.45	.70	.30	.30
15 mere stones	3.50	15.00	5.00	8.00	2.54	6.00	6.00	6.75	10.00	2.00	2.00
Total amount of bid	$129,320	$130,925	$131,617	$134,825	$139,345	$143,215	$147,098	$149,459	$153,210	$167,145	$119,275

*SEWERS.—Peoria, Ill.—Bids were received on Sept. 15 by the City Council for the construction of the North Peoria sewer. Isaac J. Levinson is Secy. The bidders submitting the following bids were: (A) GREEN & SONS CO., Chicago, Ill. (awarded contract); (B) E. R. Harding & Co., Racine, Wis.; (C) Dearborn & Jackson, Davenport, Iowa:

	(A)	(B)	(C)
10,265 lin. ft. 8" pipe sewer	$0.45	$0.60	$0.55
8,440 " " 12" " "	.75	.80	.75
10,505 " " 15" " "	1.30	1.00	1.20
5,720 " " 18" " "	1.40	1.30	1.60
2,990 " " 20" " "	1.50	1.60	1.75
2,015 lin. ft. 20 × 30" brick sewer	2.65	2.25	2.50
2,790 " " 24 × 36" " "	3.35	2.70	3.00
1,910 " " 26 × 39" " "	5.40	3.50	3.40
1,405 " " 28 × 42" " "	5.90	4.40	4.00
1,410 " " 30 × 45" " "	4.00	4.40	3.70
315 " " 32 × 48" " "	5.00	5.00	3.75
835 " " 34 × 51" " "	6.00	5.20	4.50
340 " " 46" " "	8.50	5.20	5.00
445 " " 54" " "	8.50	5.80	6.00
1,490 " " 56" " "	6.85	7.50	8.00
875 " " 60" " "	8.25	7.00	8.00
9,245 " " 60" " "	10.10	11.50	14.00
140 manholes	40.00	40.00	40.00
33 flush manholes	40.00	32.00	45.00
288 catch basins	40.00	42.00	30.00
1 outlet abutment, complete	1,200.00	500.00	1,000.00
Extra concrete, per cu. yd.	8.00	7.00	8.00
Extra lumber left in place, per M	30.00	40.00	40.00
Extra brick work, per M	16.00	25.00	20.00
Total	$219,726	$219,909	$244,088
Engineer's estimate, $221,308.			

U. S. POSSESSIONS AND CUBA.

LOCOMOTIVE CRANES.—Panama.—Bids were received as follows on Sept. 28, at the office of Capt. F. C. Boggs, Gen. Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for three locomotive cranes: American Hoist & Derrick Co., St. Paul, Minn., $21,214; 42 days' shipment. Browning Engineering Co., Cleveland, Ohio, $21,900; 15 days. Interstate Engineering Co., Cleveland, $17,400; $19,800; $20,100; $22,500; 60 days. Brown Hoisting Machine Co., Cleveland, $23,733; 42 days. McMyler Mfg. Co., Cleveland, $30,750; 120 days.

ELECTRIC RAILWAY. — Panama.—Bids were received as follows on Sept. 28, at the office of Capt. F. C. Boggs, Gen. Purchasing Officer, Isthmian Canal Commission, Washington, D. C., for the installation complete of an electric trailway system for the construction of the locks at Gatun. It consists of item 1, trackage, complete; item 2, 12 electric locomotives, and item 3, 24 flat cars: Baldwin Locomotive Works, Philadelphia, Item 3, $12,840; 120 days. Ducas & Co., 114 Liberty St., New York, item 2, for gasoline or alcohol locomotives, $59,880; one year. Westinghouse Electric & Mfg. Co., Baltimore, Md., item 1, $26,328; item 2, $24,-996; item 3, $10,936; total, $62,330; 150 days. Youngstown Car Mfg. Co., Youngstown, Ohio, item 1, $33,512; item 2, $24,000; item 3, $7,680; 200 days; total, $65,192. Atlas Car & Mfg. Co., Cleveland, Ohio, Bid A, item 1, $18,006.16; item 2, $22,710; item 3, $10,175; total, $50,872; Bid B, item 1, $18,-006; item 2, $25,881; item 3, $10,176; total, $54,153; Bid C, item 1, $18,006; item, 2, $20,-100; item 3, $10,176; total, $48,372; 190 days. Wonham-Magor Engineering Works, 29 Broadway, New York, item 1, $24,562; item 2, $24,930; item 3, $8,256; total, $57,-737; 180 days.

ENGINEERING SUPPLIES. — Panama.—Bids were received as follows on Sept. 24, at the office of the Isthmian Canal Commission, Washington, D. C., for furnishing engineering supplies as follows: 21,000 ft. water hose, 21,000 ft. armored air hose, 5,000 ft. unarmored air hose, 16,000 ft. wire-wound steam hose, 1,500 ft. suction hose, all various sizes: Boston Woven Hose & Rubber Co., Cambridge, Mass, $21,258; Cincinnati Rubber Mfg. Co., Cincinnati, $26,450, $19,-590; Diamond Rubber Co., 1876 Broadway, New York, $37,854; B. F. Goodrich Co., Akron, Ohio, $23,107; Gutta Percha & Rubber Mfg. Co., 126 Duane St., New York, $28,624; National Electrical Supply Co., Washington, $23,086; New York Belting & Packing Co., New York, $22,916.74, $23,297; Peerless Rubber Mfg. Co., New York, $27,-183; Republic Rubber Co., New York, $25,-436; Revere Rubber Co., New York, $31,089; Sprague Electric Co., New York, except water and unarmored air hose, $25,582; United & Globe Rubber Mfg. Cos., Trenton, N. J., $21,886; Trenton Rubber Mfg. Co., Trenton, N. J., unarmored air hose only, $1,820.

Four Scotch marine boilers: Casey Hedges Co., Chattanooga, Tenn., $21,900; P. Delany & Co., Newburgh, N. Y., $17,550; G. & W. Mfg. Co., 26 Cortlandt St., New York, $14,440; A. D. Granger Co., 90 West St., New York, $13,916; Harlan & Hollingsworth Corp., Wilmington, Del., $16,250; Lake Erie Boiler Works, Buffalo, N. Y., $16,500; Manning, Maxwell & Moore, 85 Liberty St., New York, $13,592; Marine Boiler Works Co., Toledo, Ohio, $13,960; Maryland Steel Co., Sparrow's Point, Md., $15,960; J. P. Morris Co., Philadelphia, $18,000; Newport News Shipbuilding & Dry Dock Co., Newport News, Va., $16,624; New York Shipbuilding Co., Camden, N. J., $15,975; Roberts Safety Water Tube Boiler Co., Red Bank, N. J., $14,-000; Samuel Smith & Sons Co., Paterson, N. J., $20,400; Springfield Boiler & Mfg. Co., Springfield, Ill., $11,904.

CIVIL SERVICE EXAMINATIONS.

*WATER-WORKS INSPECTOR. — New York, N. Y.—Notice is given by the Municipal Civil Service Commission, 299 Broadway, that applications will be received from Sept. 23 until 4 p. m., Oct. 7, for the position of Inspector, Board of Water Supply. No application received at the office of the Commission, by mail or otherwise, after 4 p. m. on Oct. 7 will be accepted. Notice of date of examination will be given later. There are about 100 vacancies. Salary, $4.50 to $5 a day. The minimum age is 22 years. F. A. Spencer is Secy.

INSPECTOR OF ELEVATORS.—New York, N. Y.—The Municipal Civil Service Commission, 299 Broadway, gives notice that applications will be received until 4 p. m., Oct. 8, for the position of Inspector of Elevators. (No application received at the office of the Commission, by mail or otherwise, after 4 p. m., on Oct. 8 will be accepted.) The examination will be held at 10 a. m., Oct. 29. F. A. Spencer is Secy.

DRAFTSMEN, INSPECTOR, HEALTH OFFICER.—Albany, N. Y.—The State Civil Service Commission will hold examinations on Oct. 17 for the following positions: Civil engineering draftsman, salary $4 to $5 a day; health officer, Town of Wells, inspector of masonry, salary $3.50 to $5 a day; structural draftsman, Public Service Commission, First District, salary $1,200 to $1,800 a year. The last day for filing applications for these positions is Oct. 10. Charles S. Fowler is Ch. Examiner.

SCIENTIFIC ASSISTANT.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on Oct. 14-15 to secure eligibles from which to make certification to fill vacancies as they may occur in the position of scientific assistant, in the Department of Agriculture, at salaries ranging from $840 to $2,000 per annum, depending upon the experience and qualifications of appointees. As a result of this examination certification will be made to fill the following-named vacancies: Scientific assistant (female), qualified in library science, $840 a year, in the Library Bureau. Scientific assistant (female), qualified in seed testing, $840 a year, in the Bureau of Plant Industry. Scientific assistant (male), qualified in food bacteriology, $1,000 a year, in the Bureau of Chemistry. Age limit, 20 years. Application Form 1312.

SUPERINTENDENT OF BUILDINGS.—Washington, D. C.—An examination is announced by the U. S. Civil Service Commission on Oct. 28-29, to secure an employee to take charge of the Buildings Division of the Government Printing Office, at a salary of $2,500 a year, and to secure eligibles from which to make certification to fill vacancies requiring similar qualifications as they may occur. Age limit, 25 to 50 years. Application Form 1312. Applications must be filed prior to closing hour on Oct. 17.

TRADE PUBLICATIONS.

POWER PUMPS.—Dean Bros. Steam Pump Works, Indianapolis, Ind. Catalog No. 71. Paper; 6 × 7¼ ins.; pp. 40; illustrated.

Motor and belt-driven plunger pumps are described and illustrated in this catalog. Both vertical and horizontal pumps are shown.

"SHORTWALL" COAL CUTTER.—The Jeffrey Mfg. Co., Columbus, Ohio. Bulletin No. 14. Paper; 8 × 10 ins.; pp. 12; illustrated.

While not presenting a technical description of the Jeffrey "shortwall" coal cutter, this bulletin gives a general idea of its method of operation and the advantages claimed for it.

BOOTS AND SHOES.—Rubberhide Co., Essex Bldg., Boston, Mass. Paper; 3½ × 6¼ ins.; pp. 16; illustrated.

"Rubberhide" boots are of rubber with leather soles. A variety of styles are shown in this booklet. These boots are "warranted to outwear two to five pairs of other kinds of rubber boots," and can be resoled.

CEMENT SIDEWALKS.—Universal Portland Cement Co., Chicago. Pp. 61; 6 × 9 ins.; illustrated.

According to the preface of this very complete little booklet, entitled "Portland Cement Sidewalk Construction," by Mr. C. W. Boynton, it is intended "to set forth the requirements necessary to obtain the best results in Portland cement sidewalk construction." It is an admirable monograph on the subject, very much better than the average trade publication.

STEAM SHOVELS.—The Browning Manufacturing Co., Mansfield, Ohio. Monthly bulletin; 6 × 9 ins.; illustrated.

The monthly bulletin of this company, averaging ten or a dozen pages a month, is devoted to descriptions and illustrations of standard and special steam shovels made by the company.

CONCRETE PILES.—Raymond Concrete Pile Co., New York, 140 Cedar St. Pp. 22; 6 × 9 ins.; illustrated.

This latest catalog of the Raymond Company is devoted to a discussion of superiority of the concrete over the wooden pile and to the specific description of the advantages of the special pile patented by the company.

WATERPROOFING.—The Waterproofing Co., 147 East 35th St., New York City. Pp. 32; 6 × 8¼ ins.; illustrated.

This company, while acting as general contractor on any waterproofing work, is an especial advocate of its hydrolithic cement, which is the main subject of this latest pamphlet. Many instances of "before-and-after taking" are shown which support the contention as to the value of the mixture.

TUMBLERS.—Whiting Foundry Equipment Co., Harvey, Ill. Catalog No. 54. Paper; 6 × 9 ins.; pp. 15; illustrated.

The catalog describes spur geared, roller drive and friction geared tumblers. Tables of principal dimensions are included. In addition to the half-tone illustrations there is a plan and elevation of the arrangement of an exhaust system for tumblers and grinder.

CEREAL MILLING MACHINERY.—H. W. Caldwell & Son Co., Chicago, Ill. Paper; 6 × 9 ins.; pp. 32; illustrated.

Special power-transmitting and material-handling machinery designed and built for the Hecker-Jones-Jewell cereal mills, New York City, is quite generally described in this artistic book. The apparatus includes rope drives, special clutches, barrel elevators, spiral lowering chutes, troughs and bins, conveyors, etc.

COAL-HANDLING MACHINERY.—C. W. Hunt Co., West New Brighton, N. Y. Pamphlet No. 081. Paper; 3¼ × 6 ins.; pp. 48; illustrated.

This is an "introduction to the general line of labor-saving machinery manufactured by C. W. Hunt Co." Both diagrammatic sketches and photographs of actual installations are shown, giving a clear idea of the character and operation of the machinery. Among the illustrations are included eight which show suggestive applications of this type of machinery to industrial plants.

REVOLVING STEAM SHOVELS.—Vulcan Steam Shovel Co., Toledo, Ohio. Paper; 4¾ × 8¼ ins.; pp. 24; illustrated.

These "Giant" steam-shovels (built in four sizes) are somewhat similar to locomotive cranes, the entire machine revolving on a turntable on the four-wheel truck. The boom carries the ordinary arrangement of dipper handle and dipper. The machine is small and compact, is operated by one man, and is specially adapted for use on small jobs where the ordinary type of machine would be too large and too costly for convenience or economy.

REINFORCED-CONCRETE CONSTRUCTION.—The Concrete Column & Construction Co., 11 Raynor St., Detroit, Mich. Paper; 4 × 9¼ ins.; pp. 56; illustrated.

The special feature of the system of concrete building construction described in this pamphlet is the use of reinforced-concrete tubular shells which serve as forms and also become a part of the structure. Concrete "lumber" for joists, studs, etc., is also included. Particulars are given as to the construction of floors, roofs, walls, etc. It is not stated whether the system has been used in the construction of any buildings.

WATER TREATMENT.—Purification & Engineering Co., 50 Church St., New York. Stiff paper; 6 × 9 ins.; pp. 31; illustrated.

This pamphlet contains information relating to the Reisert-Dervaux system of treating water for industrial purposes. The water is softened by means of lime and soda ash, filtered, etc. Sectional drawings are used to explain the general scheme of water treatment, and in addition there are many half-tones of installations. The pamphlet states that more than 3,500 plants with an aggregate capacity of over 11,925,000 gals. per hour are in operation.: Last year alone 312 plants were installed with a capacity of 1,590,000 gals. per hour.

ELECTRIC RAILWAY APPARATUS.—The General Electric Co., Schenectady, N. Y. Bulletins 4,588, 4,593, 4,600. Paper; 8 × 10½ ins.; pp. 16, 28, 24; illustrated.

Bulletin No. 4,588 describes the GE-202 railway motor, which is similar in design and construction to the latest standard railway motors, but being provided with commutating poles. The characteristics of the commutating-pole motor allow the overload to be considerably increased. At the same time a more rugged form of motor is obtained which will withstand the most severe service conditions. The motor is, therefore, especially adapted for operation on heavy grades or with equipments geared for high-speed work which have also to start and stop frequently in city service. The details of construction are given at some length in the bulletin, and an article on rating, with suggestions for the proper selection, is included. Dimension diagrams, characteristic curves and a service data sheet for use in ordering, complete the pamphlet.

No. 4,593 is on "Railway Converter Substations," and gives a general description of the various pieces of substation apparatus, including rotary converter transformers, reactances, blowers, cables, switchboards, etc., and includes illustrations of converter stations operated by various well-known railway companies. It contains also plans and elevations showing different arrangements of sub-station apparatus.

Bulletin No. 4,600, describes various types of controllers for use in connection with both alternating and direct-current motors, on electric cars, locomotives, automobiles, launches, elevators, trains, hoists, etc., and in rolling mills, machine shops, printing plants and pumping stations. The bulletin contains general data and dimensions which will be found of value to anyone contemplating the installation of motor drive.

CONCRETE MACHINERY.—Nims Concrete Machinery, Philadelphia, N. Y. Pp. 16; 5½ × 8 ins.; illustrated.

The combination machine made by this company is both a measurer and a mixer. This latest catalog gives more complete descriptions than any of the previous publications of the firm.

TOOLS.—Montgomery & Co., 105-7 Fulton St., New York City. Catalog No. 27. Paper; 4¼ × 6¾ ins.; pp. 272; illustrated.

In this catalog are listed a line of tools for machinists, blacksmiths, plumbers, carpenters, etc. An interesting feature is the fact that the prices quoted are "net," all discounts having been removed. An aluminum solder, guaranteed to satisfactorily solder aluminum to aluminum or to other metals is advertised.

MEASURING TAPES.—Keuffel & Esser Co., 127 Fulton St., New York. Paper; 6 x 8¾ ins.; pp. 8; illustrated.

A new finish for steel tapes will be used by this company hereafter. It is called the "Keco" finish, and will not only prevent the rusting of the tapes "while in stock from the effects of humidity," but will also prevent the tapes from suffering "in appearance from being handled with moist hands." Besides this, the finish "shows the numerals and graduations brilliantly and clearly upon a jet-black background, facilitating the reading." The measuring tapes here listed are provided with an adjusting device to make it possible to compensate for the wearing of the center and also to give just the winding friction desired. The circular describes and prices several styles of tapes, and also ironclad band chains, folding pocket-rules of steel, and shrinkage rules.

For other Proposal Advertisements see pages 47, 48, 49, 50, 51, of Advertisements and Construction News page 122.

SEWER.

OFFICE OF THE COMMISSIONERS OF SEWERAGE OF LOUISVILLE, KY.
Incorporated.

Sealed proposals for the construction of a sewer known as the Breckinridge Street Sewer, Contract No. 13, of the Comprehensive System of Sewerage for the City of Louisville, Ky., will be received at the office of the Commissioners of Sewerage until 12 o'clock noon, October 16th, 1908.

The work consists mainly of building a sewer to be constructed of concrete as follows: 1,223 feet, 54" diameter; 480 feet, 51" diameter; 484 feet, 45" diameter; the average depth of cut 13.4 feet; approximately 740 cubic yards of concrete.

Plans and specifications may be seen at the office of the Commissioners.

Sealed bids should be endorsed "Proposals for the Breckinridge Street Sewer," and addressed to the Commissioners of Sewerage, Equitable Building, Louisville, Ky. Each bid must be accompanied by a certified check for at least seven per cent. (7%) of the total amount of the bid or a "Bidder's Bond," as described in the form of proposal.

P. L. ATHERTON,
Chairman.

CHAS. P. WEAVER, Secy. & Treas.
J. B. F. BREED, Chief Engineer.

SEWER.

OFFICE OF THE COMMISSIONERS OF SEWERAGE OF LOUISVILLE, KY.
Incorporated.

Sealed proposals for the construction of a sewer known as Section "E" Southern Outfall Sewer, Contract No. 14, of the Comprehensive System of Sewerage for the City of Louisville, Ky., will be received at the office of the Commissioners of Sewerage until 12 o'clock noon, Oct. 21st, 1908.

The work consists mainly of building a sewer to be constructed of plain and reinforced concrete as follows: 1,965 feet, 12 ft. 3" section; 1,510 feet, 12 ft. section; average depth of cut 27 feet; approximately 5,510 cubic yards of concrete.

Plans and specifications may be seen at the office of the Commissioners.

Sealed bids should be endorsed "Proposals for Section 'E' Southern Outfall Sewer," and addressed to the Commissioners of Sewerage, Equitable Building, Louisville, Ky. Each bid must be accompanied by a certified check for at least seven per cent. (7%) of the total amount of the bid or a "Bidder's Bond" as described in the form of proposal.

P. L. ATHERTON,
Chairman.

CHAS. P. WEAVER, Secy. & Treas.
J. B. F. BREED, Chief Engineer.

ENLARGING OF DITCH.

Cerro Gordo, Piatt Co., Ill.

Sealed bids for all or part of the work will be received by the Commissioners of Drainage District No. 4, Cerro Gordo, Piatt County, Ill., up to 1:30 P. M., October 8th. For details write,

J. C. LOCHER, Town Clerk.

MUNICIPAL CIVIL SERVICE COMMISSION,
299 BROADWAY.
New York, September 23, 1908.

PUBLIC NOTICE IS HEREBY GIVEN that applications will be received from WEDNESDAY, SEPTEMBER 23, UNTIL 4 P. M., WEDNESDAY, OCTOBER 7, 1908,
for the position of
INSPECTOR, BOARD OF WATER SUPPLY.
(NO APPLICATION RECEIVED AT THE OFFICE OF THE COMMISSION, BY MAIL OR OTHERWISE, AFTER 4 P. M. ON OCTOBER 7 WILL BE ACCEPTED.)

NOTICE OF DATE OF EXAMINATION WILL BE GIVEN LATER.

The subjects and weights are: Technical, 4; Experience, 3; Mathematics, 1; Report, 2.

There will be a physical examination. Graduates of technical schools of recognized standing are desired. Assignments will be made to any part of the State, and appointees are expected to live near their work. The examination will be largely on general engineering lines, but the knowledge of candidates in questions respecting the construction of works for the storage and distribution of water will also be tested.

There are about 100 vacancies. Salary, $4.50 to $5 a day. The minimum age is 22 years.

For further information apply to the Secretary.

F. A. SPENCER,
Secretary.

Situations Wanted

(Continued from page 34.)

Bridge and Structural Engineers.

BRIDGE AND CONSTRUCTION ENGINEER (32), graduate Assoc. M. Am. Soc. C. E., employed; ten years in design and construction of all classes of railroad structures, masonry, bridges, buildings in steel and reinforced concrete. Have business and executive ability. Desires position of increased responsibility with future. Address "H. 13," Engineering News, New York. 14-1t

Civil Engineers.

CHIEF ENGINEER or Engineer of Construction, railroad (34), M. Am. Soc. Civil Engrs., open for engagement. Broad experience, including work in Mexico. Location immaterial. Address "H. B. 14," Engineering News, New York. 14-12t

ENGINEER; 9 years' experience on general engineering, construction, surveys, municipal and railroad work; good draftsman; will furnish full set of field instruments, or will take contract engineering and surveying; age 28; please state salary. Address "Z. A. 14," Engineering News, New York. 14-1t

CIVIL ENGINEER of good experience desires position; has had large variety of underground, surface and railroad surveying, mapping, designing, computing, general drafting and development of mines; can furnish unquestionable references as to character and ability. Address "D. A. 14," Engineering News, New York. 14-2t

CIVIL ENGINEER and structural steel draftsman; technical education; experienced on surveys, the construction of buildings, bridges, docks, power plants, foundations (plain and reinforced concrete), the erection and inspection of steel, sewers and railroad work. Address "C. A. 14," Engineering News, New York. 14-1t

GRADUATE CIVIL ENGINEER, 5 years' experience in charge surveys, design and construction for water-supply, concrete and steel bridge, buildings and highways; present salary, $150 per month and expenses; open Oct. 1st for engagement. Address "Z. A. 14," Engineering News, New York. 14-1t

Mechanical and Electrical Engineers.

MECHANICAL ENGINEER (33), now employed, technical education, thirteen years locomotive and Corliss engine work. Thorough draftsman and correspondent. Experienced in handling men. Fair knowledge of architecture and concrete. West preferred. Address "A. A. 14," Engineering News, New York. 14-1t

POSITION WANTED—By M. E. technical graduate; 5 years' varied experience. Address "B. A. 14," Engineering News, New York. 14-5t

MECHANICAL ENGINEER, technical graduate, with 5 years' practical experience on the testing, erection and inspecting of direct and alternating current machinery, Curtis and Parsons steam turbines, and one year drafting-room employment. Address "E. A. 14," Engineering News, New York. 14-2t

Superintendents, Managers, etc.

CONSTRUCTION SUPERINTENDENT—Engineer with instrument anywhere; any kind of work; wants position, 550 East 85th St., N. Y. "WEBB." 14-1t

ASSISTANT SUPERINTENDENT, 25, desires position, experience in laying of water and sewer pipes, reinforced concrete construction, draftsman; will go anywhere. Address "I. B. 14," Engineering News, New York. 14-1t

AMERICAN, 21 years old, desires position with civil engineer or surveyor. Knowledge of the work; small salary. Address "G. B. 14," Engineering News, New York. 14-2t

Miscellaneous Wants

I WANT to correspond with an engineer who might become interested in the concrete business in and around Greater New York, he must have 5 to $10,000 to loan for one (1) year on good security. I will give him a position as engineer, will give him 6 months' option of an interest in business, he to assume loan when option is taken advantage of. Address "F. A. 14," Engineering News, New York. 14-1t

WILL DISPOSE of valuable patents for reinforced-concrete building column, suitable for floor systems of every description, "outright" or on "royalty basis," to good reliable concern. A1 business opportunity. Address "D. A. 13," Engineering News, New York. 14-2t

SUPT. OF CONSTRUCTION of railroads, heavy concrete work, piers, water systems, pavements, sewers, etc., will invest $5,000.00 and services. Highest references given and required. Address "K. B. 14," Engineering News, New York. 14-1t

WANTED
To Dig Shallow Wells
forty to fifty feet deep. Tests for foundation purposes.
Write, JOEL HURT
235 Equitable Building, Atlanta, Ga.
14-1t

FOR SALE

WOODWORKING MACHINERY
Having closed our mill, we have the following woodworking machinery for sale cheap—Wood, 24 in. planer and matcher, H. B. Smith 24 in. pony planer, 7 in. outside moulder, Universal saw bench, rigid table, swing saw, table and Tidy gauges, mortising machine, with rack and pinion feed and boring attachment; No. 2 tenoner, Universal saw, tilting table, 16 in. jointer, C. B. Rogers 36 in. band saw, traveling Arbor cross cut saw, single spindle horizontal boring machine, belting, shafting, pulleys, cutters, &c. H. M. SMITH & SON, 78-82 Watts Street, New York. 14-1t

FOR SALE
Three
No. 4 Emerson Pumps
in A1 condition. Immediate delivery. Capacity 1200 gallons per minute. The best contractor's pump on the market.
CENTRAL PENNSYLVANIA TRACTION CO.
Harrisburg, Pa. 14-1t

FOR SALE
Vulcan "Little Giant" Traction Shovels

35 ton No 1129; 3 sets engines; high crane	$4,000
30 ton No. 1127; special trenching shovel	3,850
32 ton No. 1119; 3 sets engines	3,500
26 ton No. 1046; 2 sets engines	3,000
32 ton No. 412; 3 sets engines	3,300
26 ton No. 130; 2 sets engines	2,850

All fitted with 1¼ yd. dippers.
Also 45 ton, 1½ yd. Vulcan, Class F, No. 1254; 3 sets engines; extra high crane $4,800

JOHN B. WATSON,
Drexel Building, Philadelphia, Pa.
14-1t

BOOKS

We can save you money and render valuable assistance in the selection and purchase of books. Send for Special Circular EJ. Of interest to all engineers.

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